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Committee on the Peaceful Uses of Outer Space

National research on space debris, safety of space objects with nuclear power sources on board and problems of their collisions with space debris

Note by the Secretariat

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I. Introduction

1. At its forty-third session, the Committee on the Peaceful Uses of Outer Space agreed that Member States should continue to be invited to report to the Secretary-General on a regular basis with regard to national and international research concerning the safety of space objects with nuclear power sources, that further studies should be conducted on the issue of collision of orbiting space objects with nuclear power sources on board with space debris and that the Committee's Scientific and Technical Subcommittee should be kept informed of the results of such studies.[1] The Committee also took note of the agreement of the Subcommittee that national research on space debris should continue and that Member States and international organizations should make available to all interested parties the results of that research, including information on practices adopted that had proved effective in minimizing the creation of space debris (A/AC.105/736, para. 96).

2. Pursuant to the recommendation of the Committee, in a note verbale dated 26 July 2000, the Secretary-General requested Governments to submit any information on the above questions by 31 October 2000 so that it could be submitted to the Scientific and Technical Subcommittee at its next session. The present document has been prepared by the Secretariat on the basis of information received from Member States by 24 November 2000. Information received subsequent to that date will be included in an addendum to the present document.

II. Replies received from Member States and international organizations

Oman

[Original: English]

Oman carries out no research on space debris or the safety of nuclear-powered satellites.

Peru

[Original: Spanish]

Since Peru does not have a payload space launch capability, the topic of space debris mitigation is being considered solely from the point of view of the actual payload. In that specific context, the CONIDASAT-01 project, which is a satellite project of the National Aerospace Research and Development Commission (CONIDA) involving the design and construction of an Earth observation mini-satellite, takes into account all the factors that can help prevent the creation of debris in space as a result of the satellite's launch and operation.

[1] *Official Records of the General Assembly, Fifty-fifth Session, Supplement No. 20* (A/55/20), para. 99.

United Kingdom of Great Britain and Northern Ireland

[Original: English]

1. Introduction

1. The continued commitment of the British National Space Centre (BNSC) to addressing the space debris issue is outlined in its United Kingdom Space Strategy report (1999-2002). A key objective is to coordinate with other agencies that are also working on the threat posed by space debris. In that regard, BNSC coordinates United Kingdom activities (through the United Kingdom Space Debris Coordination Group (UKSDCG)) and ensures that they are harmonized with those of the European Space Agency (ESA) and its member States. Through its membership of the Inter-Agency Space Debris Coordination Committee (IADC), BNSC is actively pursuing international agreement on major space debris issues. It also supports the related programme of work of the Committee on the Peaceful Uses of Outer Space.

2. UKSDCG provides a forum for the coordination of all United Kingdom debris research activities. The group enables researchers to exchange information and ideas and, where possible, fosters collaborative opportunities. The next meeting will be attended by all of the major United Kingdom debris research groups from industry and academia. These include the Defence Evaluation and Research Agency (DERA), Astrium, Century Dynamics, Fluid Gravity Engineering, the Ministry of Defence and the Universities of Kent, London and Southampton.

3. IADC is an international forum for cooperation on all aspects of the debris problem. In particular, efforts within the group are focused on achieving agreement on recommended mitigation practices based on sound technical analysis of the debris problem. The United Kingdom has participated in two full meetings of IADC, the first hosted by ESA in Germany in October 1999 and the second hosted by the National Aeronautics and Space Administration (NASA) in the United States of America in June 2000. At the June meeting, BNSC offered to host the IADC meeting due to be held in 2002.

4. The United Kingdom has particularly strong debris research capabilities, which BNSC regularly calls upon for impartial technical support and advice. During the past year, United Kingdom organizations have conducted the research and development described below.

2. Measurement of the debris population

Debris detectors

5. Real-time detection in space offers valuable insight into the space debris and meteoroid environment. The detection method typically utilizes the energy of an impacting particle to trigger a measurement. The Unit for Space Sciences and Astrophysics at the University of Kent at Canterbury has maintained progress on three flight opportunities for a space debris detector known as DEBIE. For the first of those opportunities, a Finnish consortium is assisting with the construction of a unit in readiness for a flight on ESA's Project for On-Board Autonomy (PROBA) spacecraft. On the second flight opportunity, DERA's Space Technology Research Vehicle-1c (STRV-1c) satellite, all units have been integrated onto the spacecraft and launch is scheduled for the third quarter of 2000. The final flight opportunity is

on the International Space Station. The launch on ESA's Technology Research Exposure Facility will be in June 2002, with a flight duration of three years and subsequent return to Earth. This provides a rare opportunity for post-flight inspection of the retrieved surfaces.

Debris environment modelling

6. Modelling of the debris environment, its long-term evolution and the potential risks it causes to possible future space systems continues to be a major activity amongst United Kingdom debris researchers. The effect of continually introducing new assets into near-Earth space, and therefore the consequences for the debris environment, is also a key research area.

(a) Modelling the debris environment in low-Earth orbits

7. DERA's Integrated Debris Evolution Suite (IDES) debris model has been used extensively to study the long-term evolution of the low-Earth orbit (LEO) debris environment in high resolution, including the influence of LEO satellite constellations and debris mitigation measures. In particular, the model has supported BNSC participation in a number of important studies within IADC. Subsequently, the following general conclusions were reached:

(a) The deployment of hundreds of constellation satellites within a narrow altitude band will have a significant impact on the LEO debris environment, especially if no post-mission disposal is performed by constellation satellites. Constellation satellites must perform some form of post-mission disposal to remove them from the constellation operational altitude;

(b) Some form of post-mission disposal is needed in addition to passivation in LEO;

(c) The use of storage orbits in or above LEO is not recommended because of the predicted initiation of collisions in those storage orbits within a 100-year projection period and, in the absence of atmospheric drag, the storage orbit will become unstable after collisions start to occur;

(d) Both 25- and 50-year post-mission residual lifetimes for de-orbiting were predicted to be efficient in reducing future population growth. However, the lowering of perigee altitude to achieve those residual lifetimes has caused a long-term increase in catastrophic collision risk at manned mission altitudes. There was concern about de-orbit perigees located at or slightly below the altitudes of Mir and the International Space Station.

8. Further studies are needed before firm mitigation strategy recommendations can be made and international consensus reached.

9. The success of the IDES model also led ESA/European Space Operations Centre to issue a contract to DERA to develop an IDES-type model for use in ESA. The new model, called DELTA, was delivered to ESA in early 2000. DELTA provides long-term projections of the >1 mm LEO debris environment and associated mission collision risks over the next 100 years. It is already regarded as one of the most sophisticated models of its kind.

(b) Modelling the debris environment in high-Earth orbits

10. Whereas models of the current debris environment in LEO are becoming quite thorough, at high altitudes such as geostationary orbit there is much more uncertainty. An international consortium comprising the University of Kent, DERA, Onera (Toulouse), the Max Planck Institute (Heidelberg, Germany) and the University of Maryland has been awarded an ESA contract to extend modelling of space debris and other environmental factors from LEO to geostationary orbit. This work is ongoing and is due to be reported on in the next few months.

11. During the past year, the University of Southampton has been awarded a three-year grant by the Engineering and Physical Sciences Research Council to construct high-resolution models of the long-term debris environment in the geostationary orbit and neighbouring orbits. The model will include the ability to assess the collision risks to orbiting systems. This activity is the main focus of debris research at Southampton.

12. In parallel with the Southampton geostationary orbit model development, DERA is also extending the capability of its IDES model from LEO to geostationary orbit. In the spirit of cooperation, the research teams at DERA and Southampton are maintaining an active dialogue and exchange of ideas during this time.

(c) Short- and medium-term debris risks to space assets

13. The University of Southampton actively undertakes short- and medium-term debris risk assessments of major space assets using its space debris software tool (SDS). Recently, SDS has been applied to determine the medium-term (one-month) collision risk to a LEO constellation posed by the break-up of one of its member satellites. Results of the study will be presented at the International Astronautical Federation (IAF) 2000 congress in Brazil.

4. Spacecraft debris protection

14. The protection of spacecraft from hyper-velocity debris impacts is another research area in which the United Kingdom is very active.

(a) Satellite survivability modelling

15. DERA has continued to develop an innovative software model called SHIELD. The purpose of SHIELD is to evaluate the survivability of unmanned spacecraft designs and recommend appropriate cost-effective debris protection strategies. Version 1.0 of SHIELD has just been completed and is undergoing validation. A paper describing SHIELD was published at the IAF 1999 conference in Amsterdam and an invited paper illustrating some results from the model is due to be presented at the IAF 2000 congress in Brazil.

(b) Hyper-velocity impact assessment

16. Century Dynamics continues to develop and market a user-friendly hydrocode simulation tool called Autodyn to investigate hyper-velocity impacts on spacecraft structures. Recent improvements to Autodyn include material models for new materials such as Nextel and Kevlar and the addition of a technique known as smooth particle hydrodynamics.

17. Under contract to ESA, a United Kingdom consortium led by Astrium (UK) has investigated cost-effective debris shielding solutions for unmanned spacecraft. New structures, including a double honeycomb configuration and enhanced multi-layer insulation, were analysed and tested. Results showed that noticeable improvements in survivability could be achieved at relatively low cost.

International Astronomical Union

[Original: English]

The International Astronomical Union (IAU) has long regarded the accelerating interference from space debris as a serious threat to the space environment and the future of observational astronomy. IAU warmly welcomes the decision of the Committee on the Peaceful Uses of Outer Space to initiate a substantive discussion on practical debris mitigation measures and will follow it with great interest. Given the nature of IAU, members of the Union contribute to the subject as part of their professional activity in national and international space agencies, but IAU does not conduct an independent programme in the area.

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Committee on the Peaceful Uses of Outer Space

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

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I. Introduction

1. In the report of its forty-third session,[1] the Committee on the Peaceful Uses of Outer Space agreed that the Scientific and Technical Subcommittee should consider the item entitled "General exchange of views and introduction to reports submitted on national activities". In its resolution 54/67 of 6 December 1999, the General Assembly endorsed the recommendation of the Committee[2] that the Secretariat invite Member States to submit annual reports on their space activities. In addition to information on national and international space programmes, the reports could include information on spin-off benefits of space activities and other topics requested by the Committee and its subsidiary bodies.

2. Pursuant to the recommendation of the Committee, in a note verbale dated 26 July 2000, the Secretary-General requested Governments to submit any information on the above questions by 31 October 2000 so that it could be submitted to the Scientific and Technical Subcommittee at its next session. The present note has been prepared by the Secretariat on the basis of information received from Member States by 30 November 2000. Information received subsequent to that date will be included in an addendum to the present document.

II. Replies received from Member States

Argentina

[Original: Spanish]

1. The National Commission for Space Activities (CONAE), which is attached to the Ministry of Foreign Affairs, International Trade and Religion, is the Argentine space agency, which coordinates all activities connected with the peaceful uses of outer space. CONAE is currently executing the National Space Plan "Argentina in Space" for 1995-2006.

2. The cornerstones of the National Space Plan are constituted by the following facts:

(a) Argentina is a country that, owing to its particular characteristics, makes and will make intensive use of space science and technology;

(b) An analysis of the different "products" that space activities contribute to social and economic development reveals the importance for the country of the generation of complete space information cycles and the identification of the respective applications.

3. The National Space Plan has been viewed as an investment project where, on the basis of fiscal returns, it is possible to determine rationally the internal rate of return of the Plan, which is proving very advantageous for the country.

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[1] *Official Records of the General Assembly, Fifty-fifth Session, Supplement No. 20* (A/55/20), para. 119.
[2] Ibid., *Fifty-fourth Session, Supplement No. 20 and corrigendum* (A/54/20 and Corr. 1), para. 119.

National Space Plan

4. Under the general guidelines of the National Space Plan, it is necessary to revise the Plan every two years and, on each such occasion, its scope must be extended for a further two years, so that there is always a target period of at least one decade. In the course of each revision, the Plan is adapted in line with the country's capacities and requirements and with the progress made during the previous biennium, with an evaluation of the operations to be continued and the addition or deletion of projects or activities as appropriate. For such purposes, it is necessary to take particular account of global advances in space technology, the relevance of new concepts and the developments and achievements in cooperation programmes that have been implemented.

5. The last biennium has shown a substantial increase in the supply of information provided by space resources internationally. This growth in international information-sharing is linked to a large extent to increasing global awareness of the need for continuous monitoring of the environment, natural resources and changes stemming from human activity, together with the free use of previously restricted technologies.

6. As a result of this increase in the international supply of information, the effects of which will become apparent on a very wide scale over the next five years, the need has arisen for the development of new ways and means of gathering, processing, analysing and using information, with particular emphasis on the last two activities, which are connected with research and development operations and with the development of human resource skills.

7. The resources for implementing the National Space Plan are obtained from three sources: direct contributions from the Treasury; indirect contributions from the Treasury; and third-party contributions.

8. The budgetary restrictions that have arisen with regard to the funding originally anticipated under the Plan have had repercussions on direct contributions from the Treasury and have necessitated the reprogramming of the operations scheduled under the five action areas constituting the Plan.

9. The following sections describe activities in each action area.

1. Ground infrastructure

(a) Ground station for satellite data acquisition

10. The station continued to operate, without interruption, using an antenna with a diameter of 7.3 metres, and the installation of a further antenna, 13 metres in diameter, was completed. The second antenna also has satellite tracking, telemetry and command capacity. The new equipment has made it possible to improve data reception from the Land Remote Sensing Satellite (Landsat), the European remote sensing satellite (ERS) and the Système pour l'observation de la Terre (SPOT) Earth observation satellite, which has resulted in a significant improvement in the station's productivity. The station also receives data from the National Oceanic and Atmospheric Administration of the United States of America and Sea-viewing Wide Field-of-view Sensor (SeaWiFS) satellites and is expected soon to have the capacity to receive data from the Indian Remote Sensing (IRS) satellites. The installation of the new 13-metre antenna will mean a significant increase in the capacity to receive

data from satellites operated by Argentina or other countries, in particular in anticipation of the forthcoming launch of the Scientific Applications Satellite-C (SAC-C) satellite.

(b) Ground station for satellite tracking, telemetry and command

11. The station became fully operational during 1998 and has been used since December of that year and in 1999 for carrying out the SAC-A mission.

(c) New ground station for data acquisition and satellite tracking, telemetry and command

12. Work has proceeded on the design and development of a second ground station, which will be installed in the Province of Tierra del Fuego, in the extreme south of the American continent.

(d) Multi-beam and multi-band systems

13. The design of advanced multi-beam and multi-band systems for simultaneous reception from several satellites is currently under examination.

2. Satellite systems

(a) SAC-C satellite mission

14. During 1998 and 1999, the flight operations of the SAC-C satellite were examined and the environmental qualification tests were completed at the integration and test laboratory of the National Space Research Institute (INPE) of Brazil. The satellite is now at the Vandenberg base in the State of California, United States of America, pending its launch from a Delta launch vehicle in November 2000. [*Note by the Secretariat.* The satellite was successfully launched on 21 November 2000.]

(b) SAC-A satellite mission

15. As part of the SAC-C project, the SAC-A technology satellite has been developed for technological demonstration purposes with the specific objectives of gathering experience in the area of satellite mission operations and of testing critical satellite components, in particular for the SAC-C satellite. The SAC-A satellite was placed in orbit on 14 December 1998 from the space shuttle Endeavour and is operating successfully. The technological tests conducted on SAC-A involve: (a) a differential global positioning system; (b) a panchromatic remote-sensing camera; (c) a magnetometer; (d) a system for tracking the movements of the Southern Right whale; (e) solar cells developed in Argentina by the National Atomic Energy Commission; and (f) a momentum wheel developed and manufactured in Argentina.

(c) Observation and communications satellite (SAOCOM) missions (main payloads in the microwave range)

16. The different operational frequency possibilities available have been examined on the basis of the mission's main applications and operating characteristics, taking into account the latest progress in the field, and a mission definition in terms of its final technical parameters has been prepared. In addition, advances have been made in the acquisition of knowledge of the applications that are being extensively

developed at the global level, such as radar interferometry and the uses of different polarizations for improved identification of terrain characteristics.

17. An agreement has been signed with the Italian Space Agency (ASI) concerning the establishment of the Italo-Argentine satellite system for emergency management (SIASGE), under which the satellites in the Argentine SAOCOM series will operate jointly with the Italian SkyMed-COSMO satellites to provide information relevant for emergency management.

3. Information systems

18. This action area is designed primarily to ensure appropriate management of the gathering, reception, transmission, storage, processing, use and dissemination of information derived from space or through the use of space resources. The activities are centred on remote sensing issues to a large extent, in particular the identification of the requirements to be met in order to generate complete space information cycles.

(a) Regional Satellite Data Centre

19. During 1999, the CONAE Regional Satellite Data Centre (CREDAS)continued to maintain national and international Internet links for CONAE and other governmental agencies in Argentina, providing access to satellite image and related space information databases.

(b) Telemedicine project

20. The objective of this project is the development of applications and communications technologies for setting up a pilot scheme operating from the Province of Córdoba. A network has been established with its central node at the Teófilo Tabanera Space Centre, three principal nodes at hospitals in the city of Córdoba, five remote nodes in the interior of the Province and one at the Marambio base in the Antarctic. Medical inter-consultations and continuing education events have taken place involving physicians at the remote nodes. The transmission of electrocardiograms and X-ray, tomography and other images has been established.

(c) Applications in flood control

21. In view of the emergency situation caused by coastal flooding as a result of the El Niño phenomenon, in 1999 CONAE implemented a nationwide programme involving the delivery of satellite images to public agencies directly involved. All the requested images received at the CONAE ground station in Córdoba from the Landsat-5 and ERS-1 and -2 Earth observation satellites have been supplied. These images have made it possible to monitor the flood line, estimate and predict soil moisture levels, monitor the entire area liable to flooding, carry out ground mapping in order to assess moisture levels and implement a programme for the generation of a flood valley model in the medium term.

(d) Applications in non-renewable resources

22. In connection with mining operations, CONAE has maintained close links with the Argentine Geological Mining Service (SEGEMAR) and makes satellite images available to its members. The images will be used for the related mapping

work. With regard to the oil industry, human and equipment resources have been developed at the University of Cuyo in order to process and analyse satellite information. A geographic information system has been developed for use by the private sector and a digital terrain model is being finalized. CONAE provides the Military Geographic Institute with satellite images received at the Córdoba ground station for the cartographic updating work carried out by the Institute on the territory of Argentina.

(e) Applications in agriculture

23. CONAE and the Federation of Grain Harvesting Associations and Centres (FECEACOP) are conducting a joint initiative that is of considerable benefit to Argentine farmers and to all sectors concerned with marketing and industrialization. An agricultural crop information system has been developed that incorporates harvest technology and is based on the use of satellite products and climatic and hydrological variables. The Entre Ríos agricultural monitoring project involves the use of satellite technology for the purpose of obtaining accurate and updated information on agricultural production in the pilot area of Chilcas in the Province of Entre Ríos. Through the use and processing of satellite images, estimates have been made of areas of citrus fruit and cereal cultivation and of sugar cane production in Tucumán, in collaboration with the Ministry of Production of the Province of Tucumán. An inventory of renewable natural resources in Córdoba has been carried out in collaboration with the Ministry of Production of the Province of Córdoba.

(f) Terrestrial validation

24. Work is continuing on the creation of a database containing spectral signatures of the main areas under cultivation and relevant geographical parameters on the basis of a planning operation covering different geographical zones of the national territory. Measurements have been carried out in Barreal del Leoncito, in the Province of San Juan during the passage of the Landsat-5 satellite with a view to establishing a zone for future satellite calibration. CONAE has signed an agreement with the Argentine air force for the purpose of calibrating the measurements of the multimode radar system sensor on board the Argentine SAC-C satellite.

(g) Distribution of satellite images and promotion of their applications

25. The Unit for Satellite Image Distribution and Promotion of Satellite Image Applications has been in operation since 1998.

(h) Data-gathering network

26. The development of a data-gathering network using the SAC-C satellite has commenced.

4. Access to space

27. Under Decree No. 176/97, the National Executive instructed CONAE to incorporate the item "Means of access to space and launch services" into the revision of the National Space Plan on an equal basis with the generation of complete space information cycles.

28. This has been achieved by making the relevant amendments to the "Access to space" action area by the appropriate means and mechanisms, in conformity with the current national and global technological situation and in line with Argentina's foreign policy, its non-proliferation policy and the international undertakings assumed by Argentina in that connection, and by encouraging a gradual and continuous increase in the country's intellectual and technological participation. In accordance with the provisions of Decree No. 176/97, the advanced technology development work will be carried out within a framework of complete transparency and in close liaison with national bodies and international organizations in countries that are members of the Missile Technology Control Regime, primarily with Brazil and the United States of America.

5. Institutional development and basic operations

(a) J. M. Gulich Institute for Advanced Space Studies

29. CONAE has signed an agreement with the National University of Córdoba establishing the J. M. Gulich Institute for Advanced Space Studies, which provides postgraduate training and conducts research in space science and technology. The Gulich Institute is also required to become involved in CONAE's links with the national higher education and university system through workshops, postgraduate courses and projects relating to emergency management, exploitation of natural resources and environmental monitoring. In order to ensure the viability of this information technology programme, CONAE cooperation with Italy has been strengthened with a view to facilitating access to supercomputers with high processing capacity.

(b) Scientific activities

30. Other significant activities include:

(a) Selection of the second group of Argentine experiments to be carried on board the STS-101 mission space shuttle. The participants in the project are primary and secondary schools, tertiary educational establishments and universities in the federal capital and the Provinces of Buenos Aires, Santa Fé and Chubut;

(b) Continuation of the total ozone mapping spectrometer Earth probe programme for ozone measuring from satellites, in cooperation with the National Aeronautics and Space Administration (NASA) of the United States and the National University of Rosario; development of schemes to measure ultraviolet radiation from the Atacama plateau to Tierra del Fuego; and evaluation of erythemic dose and solar risk factors. The regular operation of a light intersection direction and ranging system for atmospheric aerosol and ozone profile measurement has been initiated at the Laser Research and Applications Centre (CEILAP), where a system for data collection via the Aeronet network has been set up under a CONAE/NASA agreement;

(c) Cooperation between CONAE and the French space agency, the Centre national d'études spatiales (CNES), through the Stratéole project, which is a major international project concerned with the study of the dynamics of the ozone in the Antarctic polar vortex;

(d) Continuation of the ChagaSpace project, involving the search for drugs to combat Chagas' disease, in cooperation with NASA, the Institute of Parasitology attached to the Ministry of Health and Social Welfare and research institutes in Brazil, Chile, Costa Rica, Mexico and Uruguay;

(e) Issuance of an opportunity announcement for the use of data from Argentine instruments on board the SAC-C satellite, over 80 proposals from Argentina and several neighbouring countries having been received and approved;

(f) Coordination of Argentina's participation in future space missions of other space agencies concerning the measurement of soil moisture levels, aurorae borealis and solar-terrestrial physics.

(c) Institutional links

31. CONAE provides necessary support to the National Executive on specific topics, such as the Missile Technology Control Regime and the National System of War Material and Sensitive Imports and Exports, pursuant to Decree No. 603/92.

32. In 1995, the National Registry of Objects Launched into Outer Space was set up and CONAE was designated the authority responsible for its administration. The entry relating to the SAC-A satellite was recorded in 1998.

(d) Cooperation with national institutions

33. The execution of the National Space Plan involves the participation of various Argentine scientific, technological and industrial bodies. CONAE is accordingly making progress in the related negotiations with several such bodies. A number of framework agreements have been signed with various institutions.

(e) International cooperation

34. Cooperation at the international level has included the following:

(a) *Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).* CONAE participated and assisted in the preparations for this international conference and also attended the plenary meetings and meetings of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space;

(b) *Belgium.* An agreement has been signed with the Federal Services for Scientific, Technical and Cultural Affairs with a view to Belgium's participation in the SAOCOM project through the Space Centre in Liège;

(c) *Brazil.* Work has been jointly carried out on reviewing the status of SABIA3, the Argentine-Brazilian food, water and environment data satellite;

(d) *Canada.* During 1999, CONAE continued its activities as coordinator of the Argentine groups participating in the GlobeSar2 programme sponsored by Canada. The final project meeting was held in Buenos Aires and attended by researchers from all the Latin American countries involved;

(e) *France.* An agreement has been signed with CNES regarding its provision of the Icare instrument to form part of the payload of the SAC-C satellite for the mission's scientific purposes;

(f) *Germany*. Work has continued in Córdoba on the telemedicine programme, which includes the Austral On-line Network for Medical Auditing and Teleassistance (Argonauta) project and is financed in part by the European Community, and the agricultural applications project in Entre Ríos, both in cooperation with the German Aerospace Centre (DLR);

(g) *Italy*. An agreement has been signed with ASI, in connection with the SAC-C project, concerning the establishment of the Italo-Argentine satellite system for emergency management;

(h) *Spain*. Work has been jointly carried out on reviewing the status of a joint satellite mission;

(i) *United States of America*. Work relating to the SAC-C project is continuing with NASA and the satellite was placed in orbit on 21 November 2000. As technological proof of new developments made in Argentina, the SAC-A satellite was placed in orbit, in collaboration with NASA, on 14 December 1998 from the space shuttle Endeavour. Discussions have continued with NASA on extending current cooperation to incorporate the next satellite missions under the SAC programme and on including issues concerned with education in space science and technology and telemedicine. Argentina was again invited, in the year 2000, to participate in the International Space Camp sponsored by NASA.

Brazil

[Original: English]

1. The Headquarters Agreement for operation in Brazil of the regional Centre for Space Science and Technology Education in Latin America and the Caribbean (CRECTEALC) was signed in Brasilia on 12 September 2000 by the Government of Brazil and the Secretariat of the Centre.

2. The Agreement was signed, on behalf of Brazil, by the Minister of Science and Technology, Ambassador Ronaldo Sardenberg, and on behalf of CRECTEALC by the Secretary-General of the Centre, Dr. Derli Chaves Machado da Silva. The Ambassador of Mexico in Brazil, His Excellency Mr. Jorge Navarrete, attended the signing ceremony.

3. The signing of the Headquarters Agreement will make it possible for activities of the Centre in São José dos Campos, São Paulo, to begin. The Secretariat of the Centre will continue the process of affiliation of the Centre to the United Nations, pursuant to General Assembly resolution 50/27 of 6 December 1995.

Cuba

[Original: Spanish]

1. Cuba continued developing its space-related activities in 2000 despite the country's difficult economic situation and achieved unquestionable progress of value to its sustainable development. The following activities may be mentioned in particular.

1. Remote sensing and the environment

2. Through the European Space Agency (ESA) there have recently been received, free of charge, high-resolution radar space images from ERS-1 and ERS-2, which are already being processed and form part of the project undertaken in collaboration with ESA entitled "Applications of the ERS-1 and ERS-2 radar satellite images at the research stations of the Golfo de Batabanó—Isla de la Juventud—Archipiélago de Los Canarreos". The digital processing of the satellite images has been completed, together with others obtained by different means, for the purpose of producing satellite maps of the region under study. The satellite maps will be used to gather information of interest to the municipal geographic information system (GIS) being assembled on the Isla de la Juventud, as well as for other research purposes and thematic cartography.

3. A project is being developed on the basis of scientific and technical collaboration with Mexico, incorporating remote sensing applications and GIS capabilities in the investigation and thematic cartography of the natural resources of the coastal zones and marine platform of Cuba and Mexico; some of the results obtained were presented at a symposium of the Society of Latin American Specialists in Remote Sensing (SELPER), held in Mexico in October 1999.

4. During the period in question there was continued development of an operational system for sugar cane crop monitoring using Systèm pour d'observation de la Terre (SPOT) and radar satellite images of a specific agricultural area, for the purpose of permitting subsequent coverage of the entire country.

5. The National Forestry Inventory of Cuba is under way and work is continuing on a methodology, based on satellite images, permitting the operation of an early warning system for forest fires.

6. In 2000, research was undertaken to permit quantitative determination of the surface temperature of the sea and of marine chlorophyll concentration using satellite images, with a view to applying this technique in the fisheries industry and for environmental research and conservation.

7. Also on the basis of satellite images, research continued in the area of quantitative calculation of incident solar radiation, a subject of interest for agrometeorological and climatic change studies. New research was undertaken with regard to the application of vegetation indices for the purpose of analysing the country's vegetation cover, an area of work important for agriculture and forestry as well as environmental protection. The United Nations Development Programme's Global Environment Facility project being developed in the Sabana Camagüey region has benefited from the involvement of specialists in remote sensing and GIS applications.

8. An extremely important role in weather forecasting and monitoring has been played by geostationary and circumpolar satellite images, which make it possible to obtain information from zones in the Caribbean, the Gulf of Mexico and the Atlantic lacking meteorological stations. Satellite data combined with ground observations are used in daily weather forecasting, monitoring, information supply to cyclone watch organizations and the issuance of special warnings by the Cuban Institute of Meteorology.

9. In 2000, non-stop operation of the secondary global positioning system (GPS) station (International GPS Service) was maintained, with continuous meteorological observations by a digital meteorological station (temperature, pressure and humidity). During the fourth quarter of the year it is planned to upgrade the station to a primary GIS station through a programme of cooperation with the GeoForschungsZentrum Potsdam, using the new equipment received in September 2000, and to place the GPS system on the Internet to enable data transmission on a daily and possibly hourly basis. This upgrading to primary status will appreciably improve the scope for conducting geodynamic research in the Caribbean and in Cuba itself.

10. The laser tracking system resumed operation following a complete repair of the laser head carried out in Germany in 1999 and its reinstallation in the observatory during the first half of 2000. Experimental observations were commenced in the summer and, after their completion, a series of electrical and electronic adjustments of the system will, it is hoped, enable regular observations to be resumed towards the end of 2000.

2. Space sciences

11. In the field of astronomy, observations of the Sun were continued by means of optical and radio-astronomical methods and the relaying of the data collected to centres throughout the world was maintained.

12. The research undertaken focused on solar activity of a geoeffective nature through the determination and description of coronal mass ejections (CMEs), the working hypothesis proposed being the differentiated generation of solar protons. Work was completed on a CME catalogue detailing the magnetic conditions in which such ejections originated and establishing the dynamic characteristics of CMEs in relation to their origin.

13. Other aspects studied were the manifestations of solar variability according to climatic parameters recorded in Havana. A high correlation was obtained between the behaviour of average temperature and pressure in relation to the length of the solar cycle.

14. This year saw the holding of the event Astronomía 2000, which attracted professional and amateur astronomers from Colombia, Cuba and Venezuela and which also highlighted the importance of space sciences today.

15. In honour of World Space Week 2000, the Hall of Cosmonauts at the Air Museum was remodelled and provided the venue for informal lectures and debates on astronomy and space sciences specially targeted at children and adolescents.

16. In commemoration of the twentieth anniversary of the joint Cuba-Union of Soviet Socialist Republics space flight, a talk on this important event was held on 19 September with the participation of cosmonaut Arnaldo Tamayo Méndez.

17. As regards observations of the ionosphere and the geomagnetic field, the stations concerned continued their systematic operations, sending information to data centres worldwide.

18. Research in this area succeeded in producing an empirical model for Cuba of the variation in the electron concentration of the ionosphere in magnetically quiet

conditions and for 10 levels of solar activity, a model that represents a substantial contribution, both for the study of this ionized environment and for practical purposes in the field of radio communications. The information obtained supplements existing knowledge of the non-disturbed behaviour of temporal variations of the N(h) profile over Cuba and enables new information to be incorporated into the existing database for this parameter. The model will also contribute considerably to long-term forecasting of the state of the ionosphere and radio broadcasting conditions and, ultimately, to improving radio communications.

19. A physico-morphological characterization was undertaken of the dynamic behaviour of the ionospheric plasma in the region between 15°S and 50°N latitude and 40°W and 120°W longitude, the result obtained being that ionospheric plasma characteristics vary with geomagnetic latitude, altitude, local time, season and level of geomagnetic and solar activity and that the density of the plasma tends to be greater in the equatorial regions than at higher latitudes. The basic materials used in producing this result were the daily and monthly charts for the ionospheric parameter foF2 plotted at 26 vertical-sounding stations at data centres worldwide.

3. Distance learning

20. In 2000, a campaign was started to distribute televisions and video recorders to all primary and secondary schools in Cuba as part of a major effort to spread education and culture to all corners of the country.

21. Special television programming was organized with the aim of extending general knowledge and culture to the population at large, with various courses being included on a number of subjects, with five weekly slots at two different times of day.

Czech Republic

[Original: English]

1. Launched on 29 August 1996, the latest Czech satellite, MAGION 5, has survived four years in outer space and continues scientific exploration of the auroral regions of the magnetosphere. Regular daily sessions with the satellite are carried out from the ground telemetry station at Panská Ves. Once or twice a week, attitude correction is carried out using the on-board gas-jet engine. The predicted gas supply is sufficient until the middle of 2001.

2. A Czech experiment was launched on board the United States satellite Multispectral Thermal Imager in March 2000. The hard X-ray spectrometer is a joint venture between the Astronomical Institute of the Czech Academy of Sciences and the Space Environment Center of the National Oceanic and Atmospheric Administration of the United States. The satellite measurements should demonstrate the feasibility of predicting interplanetary energetic proton events by detecting a specific type of solar flare known to associate with those events. The satellite's expected lifetime is three years, which should encompass the peak years of solar cycle 23. Czech astronomers involved in solar flare physics research will also use the data received from the experiment.

3. Czech space science activity included participation in the CLUSTER II mission. The Czech Republic contributed by developing tools for handling and processing of measured data as well as for their interpretation through numerical simulations for the WHISPER experiment. A two-way interface between two major data-processing systems using the interactive science data analysis tool and the south-west data display and analysis system has been prepared. In addition, development work continued on an ion-voltage converter, which is to be used as the front-end electronics of the new space plasma diagnostic sensor called the Langmuir probe. This new instrument has been under development for about two years in the European Space Agency (ESA) Solar System Division. It represents a significant improvement over the standard single-electrode Langmuir probe and is suitable for improving plasma diagnostic capabilities in the Earth's ionosphere and possibly magnetosphere. It may be envisaged as a plasma sensor for the Mars environment diagnostic on future Mars missions. A multi-electrode Langmuir probe instrument has been designed for the French microsatellite Demeter, due to be launched in mid-2002. The Demeter instrument, called the instrument sonde de Langmuir (ISL), is under development in collaboration between the ESA Solar System Division and the Institute of Atmospheric Physics at the Czech Academy of Sciences. Demeter/ISL represents the first flight opportunity for this new space plasma sensor.

4. A numerical code for interpretation of data from the Swedish REX experiment planned for the LUNARSAT mission is also being developed by Czech software specialists. The experiment is designed to search for the possible presence of water at the lunar South Pole.

5. Research and scientific work in the field of life sciences has included analysis and prognosis of group social interaction during complex space missions and a study on how to increase the precision and effectiveness of astronauts' psychomotoric activity in weightlessness.

6. As the first stage, a new special method has been developed based on fuzzy logic. The purpose of using this method is to map the social position of every group member and to express their positions in a manner similar to a topographic map. This method was used, for instance, in the international experiment, entitled "Simulated flight of international crew on Space Station '99".

7. The main objective of the second task was to determine an optimum way of operating the new accelerometer, which has been designed for possible use on the International Space Station. Several experimental flights were accomplished in 2000 to study the functional ability of the equipment. This activity is part of a wider experimental programme focused on psychosocial support of the space crew during docking operations. Possible application of this method is foreseen in pilot activity during landing and take-off.

8. Work on equipment for the study of solidification and crystallization processes on board the International Space Station is a major effort in materials science. The first prototype of the Advanced TITUS furnace has been completed in cooperation with the Microgravity User Support Centre of the German Aerospace Centre (DLR) and the test programme has started. Development of a new thermographic probe for studying non-equilibrium solidification has been also successfully completed. A new dumping system for vibrations inside Advanced TITUS has almost been

finished. It will decrease microgravity forces inside the furnace and thus significantly increase the quality of space experiments.

9. A workshop on space industry potential and cooperation possibilities was organized in cooperation with ESA and the European Association for the International Space Year.

Hungary

[Original: English]

Space activities in Hungary are described in the publication *Space Activities in Hungary 1998-1999* (Hungarian Space Office, Budapest, 2000), to be distributed at the thirty-eighth session of the Scientific and Technical Subcommittee.

India

[Original: English]

1. Organization of the Indian space programme

1. The Government of India established the Space Commission and the Department of Space (DOS) in June 1972 with the primary objective of promoting the development and application of space technology and space science for accelerating the socio-economic development of the nation. The policies for the Indian space programme are formulated by the Space Commission and implemented by DOS through the Indian Space Research Organization (ISRO), the National Remote Sensing Agency, the Physical Research Laboratory, the National Mesosphere-Stratosphere-Troposphere Radar Facility and other agencies.

2. The secretariat of DOS carries out the overall coordination of the space programme and the headquarters of ISRO are located in Bangalore. The space programme is implemented through the following establishments of DOS:

(a) *Vikram Sarabhai Space Center*, in Thiruvananthapuram, which is the lead centre for all rocket and launch vehicle programmes. It also carries out research in atmospheric and related space sciences through its Space Physics Laboratory;

(b) *ISRO Satellite Center*, in Bangalore, which is the lead centre for satellite technology;

(c) *SHAR Centre*, located on Sriharikota Island, about 100 kilometres north of Chennai;

(d) *Liquid Propulsion Systems Centre*, which is engaged in research and development of Earth-storable and cryogenic propulsion systems for launch vehicles and spacecraft;

(e) *Space Applications Centre*, in Ahmedabad, which conducts space applications research and development;

(f) *Development and Educational Communication Unit*, located in Ahmedabad, which is involved in the conception, definition, planning, implementation and socio-economic evaluation of space applications;

(g) *ISRO Telemetry, Tracking and Command Network*, with an integrated network of ground stations providing mission support to near-Earth orbit satellites and launch vehicle missions. The Network also operates the Local User Terminal/Mission Control Centre under the International Satellite Systems for Search and Rescue (COSPAS-SARSAT) programme;

(h) *INSAT Master Control Facility*, located at Hassan in Karnataka, which is responsible for initial orbit raising, payload testing and in-orbit operation of all INSAT satellites;

(i) *ISRO Inertial Systems Unit*, Thiruvananthapuram, carrying out research and development related to inertial sensors and systems required by satellites and launch vehicles;

(j) *National Remote Sensing Agency*, Hyderabad, an autonomous institution supported by DOS, responsible for acquisition, processing and distribution of data from remote sensing satellites. The Agency also runs the Indian Institution of Remote Sensing in Dehra Dun;

(k) *Physical Research Laboratory*, Ahmedabad, an autonomous institution supported mainly by DOS, carrying out research in space and allied sciences;

(l) *National Mesosphere-Stratosphere-Troposphere Radar Facility*, a national facility for national and international scientists to conduct atmospheric research;

(m) *Antrix Corporation Limited*, Bangalore, the apex marketing agency under DOS to market subsystems and components for satellites and satellites to user specifications and providing launch services and tracking facilities.

2. Space systems commissioned in India

3. India has established two major space systems that form important elements of national infrastructure:

(a) *The Indian National Satellite (INSAT) system*, commissioned in 1983, is a multipurpose satellite system for telecommunication, television broadcasting, business communication, mobile communication, search and rescue and meteorology. The INSAT system comprises five satellites: INSAT-2B, INSAT-2C, INSAT-2D, INSAT-2E and INSAT-3B. INSAT-3B, the newest satellite, was launched on 22 March 2000. In addition to telecommunication and other regular broadcasting services, INSAT is widely used for interactive educational television in rural areas. The meteorological imaging capability and the direct-to-community broadcast capability of INSAT help in issuing warnings of impending cyclones and in undertaking evacuation of people likely to be affected. INSAT satellites also carry transponders for satellite-aided search and rescue as part of the international COSPAS-SARSAT programme. INSAT-3A and INSAT-3C—INSAT-3E are to be launched in the coming years;

(b) *The Indian Remote Sensing Satellite (IRS) system*, commissioned in 1988, has a constellation of six remote sensing satellites, including IRS-1B, IRS-1C, IRS-1D, IRS-P3 and IRS-P4. IRS-P4 was launched on 26 May 1999 by India's own polar satellite launch vehicle (PSLV). The data from IRS satellites is used for several applications covering agriculture, water resources, urban development,

mineral prospecting, environment and forestry, drought and flood forecasting and ocean resources. The integrated mission for sustainable development is a major mission undertaken in India using space-based data along with collateral socio-economic data. IRS-P5 (CARTOSAT) and IRS-P6 (RESOURCESAT) are planned for launch in the coming years.

3. Launch vehicle development

4. India has developed and commissioned its PSLV for launching 1,200 kilogrammes IRS-class remote sensing satellites into 820 kilometres polar Sun-synchronous orbit. It can also put a higher payload into low-Earth orbit. A geosynchronous satellite launch vehicle (GSLV) for launching 2,500 kilogrammes INSAT-class satellites into geosynchronous transfer orbit is now under development. The first test flight of GSLV is planned in 2000-2001. A range of sounding rockets has also been developed for conducting scientific experiments in the lower and upper atmosphere.

4. Activities in space sciences

5. Research programmes in space sciences are undertaken in the disciplines of astronomy and astrophysics, planetary and space sciences, Earth sciences, theoretical physics, laser physics and quantum optics. India has flown gamma ray and retarding potential analyser payloads on its Stretched Rohini Satellite Series-C2 (SROSS-C2) satellite launched in 1996. IRS-P3, launched in March 1996, carries an X-ray astronomy payload. Several ground-based facilities for space sciences, including a mesosphere, stratosphere and troposphere radar have been set up.

5. Infrastructure for the space programme

6. India has established a good infrastructure for executing its space programme. This includes facilities for development of satellites and launch vehicles and their testing, launch infrastructure for sounding rockets and satellite launch vehicles, a telemetry, tracking and command network and data-reception and -processing systems for remote sensing. A number of academic and research institutions as well as industries participate in the Indian space programme. Several Indian industries have the expertise to undertake sophisticated jobs required for space systems.

6. Commercial space services from India

7. Indian space capabilities are available to international customers through the Antrix Corporation of DOS. Some of the commercial agreements include reception of IRS satellite data by ground stations in Dubai, Germany, Japan, the Republic of Korea and the United States of America, lease of transponders on board INSAT-2E to INTELSAT, providing telemetry, tracking and command support and launching scientific instruments on board sounding rockets. The satellites Kitsat-3 of the Republic of Korea and DLR-Tubsat of Germany were launched on board India's PSLV in May 1999 under commercial contracts.

7. International cooperation

8. International cooperation has been the hallmark of the Indian space programme. India has memoranda of understanding with several space agencies in

the area of the peaceful uses of outer space. It participates in international space forums, including the United Nations, the International Astronautical Federation, the Committee on Space Research and the Committee on Earth Observation Satellites. India hosted the second ministerial conference of the Economic and Social Commission for Asia and the Pacific on space applications in New Delhi in November 1999.

9. India hosts the regional Centre for Space Science and Technology Education in Asia and the Pacific, which is established on the basis of affiliation to the United Nations. It offers training in space applications to personnel from developing countries under the programme entitled "Sharing of Experience in Space" (SHARES).

10. As part of the international COSPAS-SARSAT network, India has set up the Local User Terminal and the Mission Control Centre and has also flown search and rescue payloads on board its INSAT-2 satellites. ISRO and the French space agency, the Centre national d'études spatiales, signed a statement of intent in November 1999 for a joint Megha Tropiques Mission that is aimed at enhancing the understanding of tropical weather and climate.

Peru

[Original: Spanish]

1. National programme of space activities

1. The National Aerospace Research and Development Commission (CONIDA) of Peru has signed a cooperation agreement with the Indian Space Agency and is about to sign a similar agreement with the Space Agency of the Russian Federation. In this way, CONIDA is seeking to establish closer links with space agencies in other countries through international cooperation and technical assistance programmes that will make it possible to make use of new knowledge in this area and the latest advances in space technology.

2. In this connection, the small satellite programme currently being implemented by CONIDA will at a future stage receive support and assistance from two major international space agencies.

2. Spin-off benefits of space activities

3. The impetus given by the Government of Peru to space activities has indirectly promoted the acquisition of specialized skills in space technologies by professional persons. In this connection, the CONIDA Centre for Space Studies is providing advanced training courses for public and private sector professionals in different aspects of remote sensing technology, digital processing of satellite images, geographic information systems (GIS) and global positioning systems (GPS). A total of 258 professionals received specialized training in 1998 and 262 in 1999.

4. Under an agreement concluded between the National University of Engineering (UNI) of Peru and CONIDA, a master's degree programme is being conducted in aeronautical engineering with non-manned vehicles as a special field of study to provide postgraduate tuition in this area to professional engineers and

scientists. The first group of participants in this programme is expected to graduate in March 2001.

5. The widespread use of Earth observation satellite images has provided the competent authorities with improved information about the situation in the country regarding the impact of natural disasters, with a view to maximizing the utilization of natural resources.

3. Dissemination via the Internet of information on activities of the National Aerospace Research and Development Commission

6. CONIDA now has a comprehensive Web page, which provides its users with information on the projects it carries out, the programmes being conducted and the current specialized training programmes being offered to professionals in the private and public sectors. The electronic address of the Web page is http://www.conida.gob.pe.

Philippines

[Original: English]

1. Introduction

1. Space technology and its varied applications have come to play vital and indispensable roles in our daily lives. The growing telecommunications and Internet industries in the Philippines in particular and in the region as a whole depend quite inevitably upon the infrastructure of a constellation of telecommunications satellites hovering above Earth. Earth observation, through environmental satellites, has made it possible to mitigate and plan better ways of preserving dwindling and fragile Earth resources, brought about by societal progress and development. Downstream applications and varied spin-off benefits from space research are, indeed, endless.

2. A wide spectrum of space technologies, including satellite remote sensing and geographic information systems (GIS), satellite meteorology, satellite communications, environmental and disaster monitoring systems and others, have been used comprehensively to provide information needs for an environmentally sound and sustainable development planning process, and to assist in poverty alleviation. Furthermore, they have gained increasing acceptance and have contributed significantly and cost-effectively to promoting social and economic development in the Philippines. The Science and Technology Coordinating Council-Committee on Space Technology Applications (STCC-COSTA), through a combined synergy with other government agencies and the private sector, has initiated a number of research and development projects on space technology applications.

3. The present report highlights the major accomplishments of STCC-COSTA for the period 1992-1999. It also presents continuing programmes and projects being implemented, in keeping with the mandate to develop the advanced science and technology sector, with particular emphasis on the emerging field of space technology applications. The Committee appreciates the cooperation of partners in academia, industry and other government agencies in these initiatives. More

importantly, it thanks them for sharing their vision and commitment of making space technology applications work for the nation's progress and development.

2. Space technology applications in all types of day-to-day activity

4. Since the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space was held in Vienna in 1968, the world has witnessed unparalleled growth and development in space exploration as well as in space science and technology applications.

5. Today, space is teeming with activity. It is interesting to note the reality of things that are hovering several thousand kilometres above us. Taking shape slowly but surely is the International Space Station, an ambitious undertaking of a consortium of Governments and space agencies being spearheaded by the National Aeronautics and Space Administration of the United States of America and the European Space Agency (ESA). This project, which, only decades ago, merely caught the fancy of science visionaries and which seemed to be taken from the pages of science fiction books, has now taken form in Deep Space 1. Designed to be propelled by ion propulsion by harnessing the vast amounts of interstellar hydrogen, this intrepid human machinery may in fact pave the way for cheap and feasible human interstellar travel. Soon enough and quite inevitably, most economic activities and even human habitation will take place in space.

6. There is the resurgence of realization that space technology has come to play increasing and important roles in the national, economic and social development of individual countries. The most widely recognized benefit from space technology is that of telecommunications for telephony and broadcasting using geosynchronous satellites. Space telecommunications has made it possible to link remote places, which has given rise to facilities such as electronic mail, distance education and telemedicine. Space remote sensing or Earth observation has made possible the collection of invaluable data of earthly phenomena, which can generate useful information for the effective management of natural resources and the environment, disaster mitigation, weather forecasting and strategic planning of the country.

7. Recent environmental phenomena such as the El Niño Southern Oscillation and La Niña phenomena, as well as parallel global socio-economic issues, further underscore the need for greater efforts at enhancing environmental benefits from the technology and make it imperative to formulate better strategies that will have a greater impact on the marginalized segments of society. Hence, as the pace at which space technologies continue to develop increases, nations will probably search for ways and formulate schemes to increase efficiency and reap the benefits from developments in the space sector.

8. The uses of satellites for applications in meteorology, positioning and navigation, communications, remote sensing and scientific research have grown so much that they have permeated all aspects and levels of global society. Continued efforts at developing and advancing space technologies could yield new industrial technologies in such fields as materials science, robotics, electronics, communications and information processing. Through the decades, it could be observed that there have been myriad new developments in sensor and platform systems design, unceasing improvements in instrumentation and refinements in techniques and methodologies for data acquisition, processing and management.

The fast-paced and ever-changing developments in information technology, coupled with the emergence of new exotic materials and processing systems, have greatly bolstered the use of space technology for the benefit of humankind and its environment.

9. From its nascent nature as a purely experimental and exploratory science, space technology has greatly broadened into other operational applications. Today, space technologies, in particular remote sensing, have become invaluable in all aspects of environmental management, from natural resources mapping and monitoring to hazard monitoring and disaster mitigation, to urban planning. A revitalized space-based hazard mitigation system that provides a synoptic view of impending hazards, enables swift decisions to be made, thereby lessening the effects that might be wrought by natural disasters.

3. Ministerial Conference on Space Applications for Development in Asia and the Pacific

10. The Ministerial Conference on Space Applications for Development in Asia and the Pacific was held in Beijing from 19 to 24 September 1994. The Ministerial Conference launched the Regional Space Applications Programme for Sustainable Development (RESAP) through the adoption of the Beijing Declaration on Space Technology Applications for Environmentally Sound and Sustainable Development in Asia and the Pacific, the Strategy for Regional Cooperation in Space Applications for Sustainable Development and the Action Plan on Space Applications for Sustainable Development in Asia and the Pacific.

11. The Strategy provides a general policy instrument for cooperation and coordination on space applications at both the national and regional levels and for the implementation of the RESAP. It also outlines national and regional mechanisms for building the capacity of member countries to use space technology applications for natural resource accounting, environmental management, disaster monitoring, poverty alleviation and sustainable development planning and lays down the framework for execution of RESAP through a regional approach. RESAP serves as the vehicle for realizing the goals set forth in the Strategy and the Action Plan.

4. Regional initiatives in the implementation of the recommendations of the Ministerial Conference

12. The Action Plan on Space Applications for Sustainable Development in Asia and the Pacific, formulated during the first Ministerial Conference, addresses a number of major macro-level issues and outlines the required course of action for national-level implementation. Although this course of action is subject to adjustments by Governments, there are certain prerequisites for its success. These are:

(a) Political commitment for the promotion of space applications at the national level and integration of space technology with development planning;

(b) Stress on intersectoral, regional and international cooperation, training and education, scientific research and development, and information services; and

(c) Allocation of adequate resources on a regular basis for those activities and institutional arrangements for national coordination.

13. At the national level, there has been steady progress in the implementation of the Strategy and the Action Plan. The activities range broadly from national policies and strategy formulation, programming and planning and institutional restructuring. Examples of such activities include the re-orientation of new space policies in Japan to emphasize an application-driven strategy and approach for international and regional cooperation in space technology development. A number of countries, such as China and Mongolia, have formulated their national Agenda 21 plans by integrating space technology into sustainable development planning. Fiji, Nepal and Viet Nam have also started to incorporate space applications into their environment and development programmes. Several countries, including Malaysia and Thailand, are preparing comprehensive national strategies on space technology development and applications. Countries like India have further enhanced their national programmes in space applications for integrated environment and natural resource management. The Government of the Republic of Korea has endorsed a new long-term national space programme with a total budget of $6 billion, including the development of 19 satellites for natural resource and environmental management. At least nine countries in the region, including Australia, China, Malaysia, Pakistan, the Republic of Korea, Singapore and Thailand, are currently developing small satellite programmes for Earth observation, environmental management and disaster monitoring. The Government of Indonesia invested more than $100 million in establishing a spatial information system for land and coastal resource management. The Governments of the Cook Islands, Fiji, the Islamic Republic of Iran, Samoa and Sri Lanka have also started national land and coastal management systems using integrated remote sensing and GIS technologies.

14. Institutionally, several countries have taken the necessary action to enhance national coordinating mechanisms on space technology development and applications. The Government of Australia has re-engineered its national coordinating mechanism with the Commonwealth Scientific and Industrial Research Organization as the national coordinating body on space affairs. Many countries, such as the Islamic Republic of Iran, have established a new national committee on space technology development and applications.

15. At the turn of a new millennium, not only will nations and sectors of society be continuously confronted with the impact of dynamic technological development, but they will correspondingly be faced with emerging and rather mundane issues and perennial concerns about the utilization and application of space technologies.

16. Considering the headway made by various nations in and around the region, it is high time for the Philippines, in particular, to outline a concrete programme for harnessing the huge potential and applications of space technology for sustainable development. While most public and private entities are cognizant of space technology as an enabling technology and are very interested in embarking on use of such technology, it is impossible for individual agencies involved in the use of space technologies to initiate a comprehensive and effective space programme independently. This is because technology development demands employment of a large number of specialists covering a broad spectrum of disciplines, as well as expensive infrastructure. The inter-agency approach can collectively address a whole range of issues connected with developing and implementing space programmes in a more cost-effective manner. Collaborative efforts are in fact necessary to meet particular needs of member countries with complementary

capabilities and technological levels and a like-minded approach to space programmes, which agencies may not be able to attain individually.

17. Under the aegis of the Department of Science and Technology, STCC-COSTA is an embodiment of such a collaborative effort among and between like-minded agencies involved in the use and application of space technologies. Since its inception in the early 1990s, STCC-COSTA has been able to implement a number of research and development projects, mostly in remote sensing and GIS, and has hosted and coordinated several international workshops and conferences. A concrete national framework and strategy for space technology applications research and development, however, still has to be laid down. A national space technology applications research plan is thus in order.

18. The National Space Technology Applications Programme will spell out the areas that will be the focus of scientific and technological efforts in all aspects of space technology use and development in the Philippines. It is part of a series of measures that will be pursued to achieve the common vision of the Philippines to become a knowledge-based economy in the medium term (1999-2004). The Programme emphasizes the development and utilization of superior space technologies to a level of competitive advantage and is intended to run in parallel with the currently outlined national and regional programmes, which include but are not limited to the National Science Technology Agenda and the Regional Space Applications Programme for Sustainable Development.

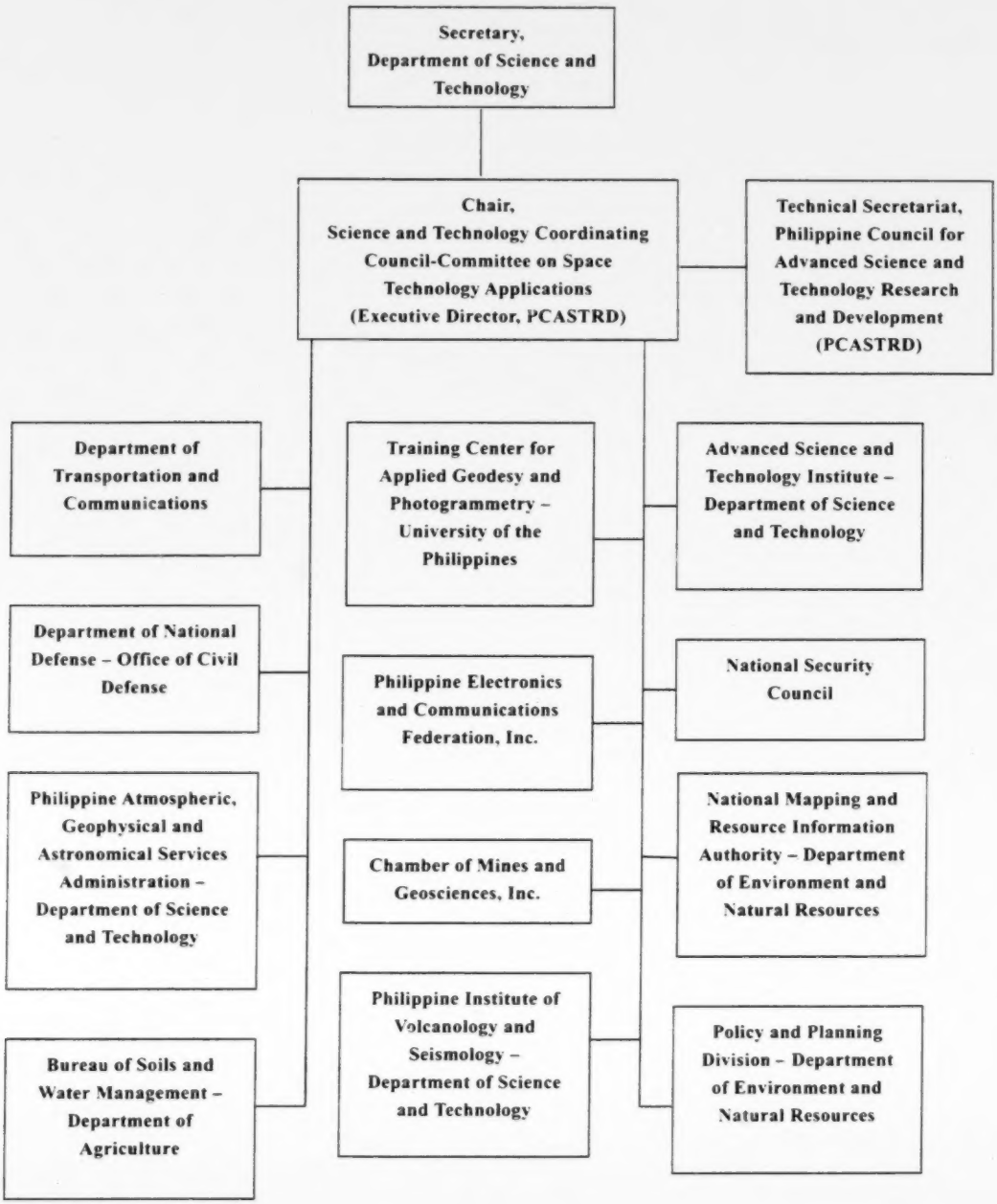
5. Philippine initiatives in the application of remote sensing technology

19. Remote sensing and GIS technologies have now been used in a wide spectrum of applications in the country for more than two decades. Appropriate actions are being undertaken to guarantee the sustainability and continuity of the application of those technologies. In more recent years, the increasing number of agencies that are using those technologies either directly or indirectly were the precursors to the creation of a national body composed of several government agencies and representatives from private sector. STCC-COSTA currently coordinates and oversees national inter-agency activities and projects in remote sensing and other space technology applications.

20. STCC-COSTA had humble beginnings and was an offshoot of the Philippine/Australian remote sensing project in the early 1990s. The increasing role of remote sensing became apparent in 1992 and thus paved the way for the creation of the National Coordinating Council for Remote Sensing. In 1995, by virtue of STCC resolution No. 4, the Council was converted into STCC-COSTA.

21. Several projects have been initiated by the Philippines in collaboration with international organizations and agencies. One of the earliest major projects spearheaded by STCC-COSTA was the Commission on Environmental Cooperation ESA/Association of South-east Asian Nations (ASEAN) natural resource and environment management project. This project aimed to enhance local capability in processing data from ERS-1 and the Advanced Very High Resolution Radiometer (AVHRR) sensor. This included equipment upgrading as well as training of technical personnel from the Philippine Atmospheric, Geophysical and Astronomical Administration (PAGASA) and the National Mapping and Resource Information Authority (NAMRIA).

Figure 1
The Science and Technology Coordinating Council-Committee on Space Technology Applications: organizational chart


Secretary, Department of Science and Technology
Chair, Science and Technology Coordinating Council-Committee on Space Technology Applications (Executive Director, PCASTRD)
Technical Secretariat, Philippine Council for Advanced Science and Technology Research and Development (PCASTRD)
Department of Transportation and Communications
Department of National Defense – Office of Civil Defense
Philippine Atmospheric, Geophysical and Astronomical Services Administration – Department of Science and Technology
Bureau of Soils and Water Management – Department of Agriculture
Training Center for Applied Geodesy and Photogrammetry – University of the Philippines
Philippine Electronics and Communications Federation, Inc.
Chamber of Mines and Geosciences, Inc.
Philippine Institute of Volcanology and Seismology – Department of Science and Technology
Advanced Science and Technology Institute – Department of Science and Technology
National Security Council
National Mapping and Resource Information Authority – Department of Environment and Natural Resources
Policy and Planning Division – Department of Environment and Natural Resources

22. In 1995, the National Coordinating Council for Remote Sensing in cooperation with the Remote Sensing Technology Centre of Japan, held the one-week Fourth Regional Remote Sensing Seminar on Tropical Ecosystems Management in Subic, Olongapo City. The seminar provided scientific and technical information on the uses of remote sensing technology in tropical terrestrial management. In 1996, financial assistance was given by the Department of Science and Technology–Philippine Council for Advanced Science and Technology Research and Development to hold the United Nations/ESA/Philippine Workshop on Microwave Remote Sensing Applications.

23. Under the auspices of the University of the Philippines-Open University and the Economic and Social Commission for Asia and the Pacific (ESCAP), a Regional Seminar on Satellite Communication Applications for Distance Education was held in 1997 in order to establish the viability of implementing educational courses and programmes through the use of satellites.

24. The country has also joined the ASEAN/Australian project on topographic mapping using remote sensing technologies with NAMRIA as the lead implementing agency. The NAMRIA project team held discussions with their Australian counterparts in April 1998 to present the accomplishments so far and identify constraints that might hamper the implementation of the project.

25. A milestone project entered into by STCC-COSTA is the Pacific Rim mission (PACRIM) of NASA. Phase I of the Philippines NASA-AirSAR was funded by the Department of Science and Technology with technical assistance from the NASA Jet Propulsion Laboratory and the University of New South Wales, Australia. The development objective of this project was the promotion of the use of airborne synthetic aperture radar (AirSAR) data for various applications relating to natural resource management and development planning. Five research studies are being implemented by six government agencies and a private firm or three study sites. Phase II activities of the project, which are under way, are concerned with information processing and extraction, interpretation and map generation for the selected sites.

26. The land use/land cover change project was completed in 1997 as an activity financed by the International Geosphere-Biosphere Programme, the global change System for Analysis Research and Training, the South Asian Regional Cooperation countries and ASEAN. The project established the methodologies for identifying parameters of change in land use/land cover that could be used in the development of a model for predicting such change using socio-economic factors.

27. Two projects that have been implemented recently made use of Advanced Earth Observing Satellite (ADEOS) data. These projects, entitled "Monitoring Lahar using ADEOS data" and "Chlorophyll study of the Lingayen Gulf using ADEOS", were funded by the National Space Development Agency (NASDA) of Japan through RESTEC and ESCAP. These projects were implemented by the University of the Philippines Training Centre for Applied Geodesy and Photogrammetry and the Marine Science Institute respectively.

28. With the occurrence of El Niño, the country suffered from forest and brush fires, in particular on the island of Palawan. There was difficulty in obtaining clear and useful images that would indicate the stricken areas. Despite this predicament, analysis of archived satellite images was undertaken in order to assess the original

vegetative cover of the affected areas and to present the results and their possible impact to decision makers for policy and strategy formulation.

29. A part of the Philippines' initiatives towards regional commitment includes the passing of a legislative bill to promote modernization of natural resource and environmental management using space technology, better known as the NAMRIA Modernization Bill.

6. Philippine initiatives in satellite-based communications

30. In the mid-1990s, through a synergy between private giant telecommunications and broadcasting firms, the Agila I and II satellites were launched into orbit. Agila I was ill-fated and thus the launch of Agila II was indeed called for. The Agila fleet consists of telecommunications satellites that were launched to address the burgeoning demand of the telecommunications and commercial broadcast industries in the Philippines. The Agila II satellite has a large ground footprint and access by neighbouring Asian countries may thus be made available. To date, Agila II is one of the most formidable satellites of its class in the region.

31. Agila II, the first high-powered telecommunications satellite, built by Space Systems/Loral (SS/L) for the Mabuhay Philippines Satellite Corporation, was successfully launched into orbit on 20 August at 1.50 a.m. local time aboard a Long March 3B rocket from the Xichang Satellite Launch Centre. The Agila satellite reinforces SS/L's dominance in the emerging domestic and international market for advanced high-powered broadcast satellites. The satellite has more than 9 kilowatts of total telecommunications satellite in service in the Asia-Pacific region. The high-powered spacecraft will allow the Mabuhay Philippines Satellite Corporation to transmit more than 190 channels of high-fidelity digital programming to cable companies and home satellite dishes and to handle more than 50,000 simultaneous two-way telephone conversations.

32. The Agila satellite operates 30 C-band transponders at 27 watts and 24 Ku-band transponders at 110 watts that are combinable to 12 high-power transponders at 220 watts. The satellite features the largest number of active transponders of any satellite in the region and has a high power-to-mass ratio, making it one of the most efficient satellites in the industry. Agila II has an expected service life of over 12 years.

33. In addition to designing and manufacturing the satellite, SS/L has provided satellite control ground station equipment in Subic Bay, the Philippines, and has trained the Mabuhay Philippines Satellite Corporation personnel to operate the satellite after completion of on-orbit testing. SS/L will conduct the on-orbit testing from its mission control centre located in Palo Alto, United States, and from the Mabuhay Space Centre in Subic Bay.

34. The Agila II design uses SS/L's flight-proven three-axis, body-stabilized FS-1300 bus, tailored to accommodate the required communication payload. The modular design and construction of the FS-1300 platform supports reliable long-life operation with an integral bipropellant propulsion system to place the satellite on station. A three-axis momentum bias system accurately maintains attitude stability on-orbit throughout the satellite's life. Deployable solar arrays supplemented with high-energy nickel-hydrogen batteries provide uninterrupted electrical power to the spacecraft.

35. SS/L is a full-service provider of commercial communications satellite systems and services, including launch services, insurance procurement and long-term mission operations from its mission control centre in Palo Alto. SS/L currently has a total backlog of more than 80 spacecraft. In addition to building Agila, the company is the prime contractor for the Globalstar low-Earth-orbit satellite system and the builder of INTELSAT, N-STAR, APSTAR, Telstar, M2A and CHINASAT communications satellites, audio-radio satellites for CD radio, direct broadcast satellites for TCI/Tempo, MCI, PanAmSat and L-STAR, the latest series of weather watch satellites, the Geostationary Operational Environmental Satellite (GOES) and the Japanese MTSAT, the next-generation Japanese air traffic control and weather watch satellite.

36. On 17 March 1998, former President Fidel Ramos signed Executive Order 467, entitled "Providing for a national policy on the operation and use of international satellite communications in the country". The promulgation of the policy is in response to the need to broaden access by authorized entities to international fixed and mobile satellite systems and services in order to accelerate the attainment of the development thrusts for the local telecommunications sector. Some of the salient features of the executive order are as follows:

(a) Direct access to all international fixed and mobile satellite systems by all international telecom carriers;

(b) Direct access to international satellite systems by broadcasters and operation of satellite news gathering Earth stations owned or operated by foreign news media organizations, for a limited period of time as defined by the National Telecommunications Commission;

(c) Access to global mobile personal communications by satellite (GMPCS).

37. On 28 February 1998, the Department of Transportation and Communications issued Department Circular No. 98-01, entitled "Global mobile personal communications by satellite (GMPCS) policy". This policy allows duly enfranchized telecommunications entities having appropriate authorization from the National Telecommunications Commission to offer GMPCS services in the Philippines. Subsequently, the Implementing Guidelines on International Satellite Communications were issued by the Commission on 29 March 1998. Likewise, on 8 November 1998, the Commission issued Memorandum Circular 11-8-98, entitled "Allocation of radio frequencies for the GMPCS".

7. Hosting of international conferences and meetings

38. Several activities were conducted in support of capacity-building and human resource development activities. The Training Centre for Applied Geodesy and Photogrammetry of the University of the Philippines holds short courses annually to serve the needs of agencies and individual clients in the use of remote sensing and GIS technologies. As part of the Philippines-NASA AirSAR project mentioned above, technical workshops are being held for the duration of the project.

39. On 22 and 23 May 1998, STCC-COSTA, through the National Mapping and Resource Information Authority, hosted the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development, steered by ESCAP. The meeting, held in Cebu, reviewed among other

things the implementation of the recommendations of the Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific and the Beijing Declaration. It also evaluated the regional programme entitled, "Integrated application of geographic information systems and remote sensing for sustainable natural resources and environmental management". Reports from the regional working groups on the following subjects were also considered: remote sensing, geographic information systems and satellite-based positioning; satellite communications applications, meteorological satellite applications and natural hazard monitoring; and space science and technology applications.

40. The Philippines also hosted the Nineteenth Asian Conference on Remote Sensing in Manila from 16 to 20 November 1998. The event is an annual conference organized by the Asian Association of Remote Sensing based in Tokyo. The Conference was attended by delegates from government and private institutions in south-east Asia as well as the Asia-Pacific Rim. Several meetings and technical sessions were held simultaneously during the event. These included the Pacific Rim II deployment of NASA. Coincidentally, the Third Meeting of Principal Investigators (Philippines) for ADEOS of NASDA was also held during the Asian Conference on Remote Sensing.

41. In the last quarter of 1998 and early 1999, coordination and exploratory meetings were held with representatives of NASDA on several satellite utilization projects. Project proposals were consolidated and submitted for consideration under the Engineering Test Satellite VIII/Gigabit Satellite and the JCSAT/AI3 programmes.

8. Summary of STCC-COSTA activities

42. A summary of projects completed and ongoing under the auspices of the STCC-COSTA is provided below:

(a) Research and development projects:

(i) Philippine/Australian remote sensing project (1990-1992);

(ii) Commission on Environmental Cooperation/ESA/ASEAN natural resource and environment management project (1989-1990);

(iii) Philippines/NASA/AirSAR project, phases I and II (1996-present);

(iv) Land use/land cover change project (1990-1997);

(v) ASEAN/Australian project on topographic mapping using remote sensing technologies (1998-present);

(vi) Monitoring Lahar using ADEOS data (1996-1997);

(vii) Chlorophyll study of the Lingayen Gulf using ADEOS (1996-1997);

(b) Training courses and conferences:

(i) Fourth Regional Remote Sensing Seminar on Tropical Ecosystems Management (1995);

(ii) United Nations/ESA/Philippine Workshop on Microwave Remote Sensing Applications (1995)

(iii) Nineteenth Asian Conference on Remote Sensing (1998);

(iv) Radar workshops conducted by the NASA Jet Propulsion Laboratory in connection with the AirSAR project (1998);

(c) International and regional working group memberships:

(i) Representation at the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III);

(ii) Representation in the ESCAP regional working groups on:

a. Remote sensing, GIS and global positioning;

b. Satellite communication applications;

c. Meteorological satellite applications and natural hazards monitoring;

d. Space sciences and technology applications;

(iii) Representation in the Intergovernmental Consultative Committee on the Regional Space Applications Programme for Sustainable Development;

(iv) ASEAN Expert Group on Remote Sensing;

(d) Policy formulation;

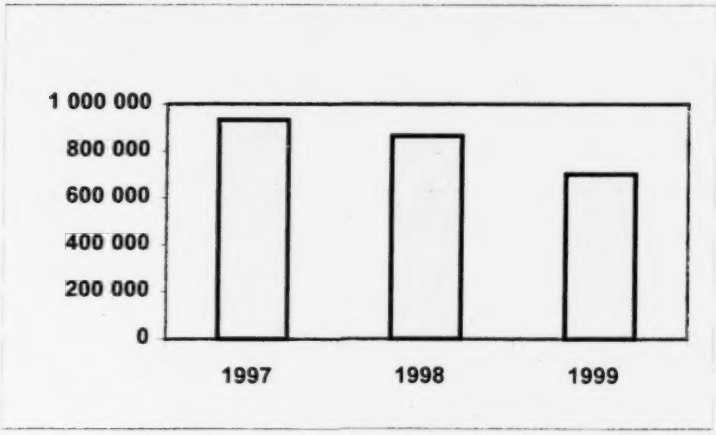
(i) Inter-Agency Task Force on Land Water Information System;

(ii) Inter-Agency Task Force on Geographic Information.

Budget

43. Around 932,000 Philippine pesos (P) was earmarked for calendar year 1997 for STCC-COSTA activities, compared with P 865,000 and P 700,000 for 1998 and 1999, respectively. Most of the project funds were utilized for the attendance of different STCC-COSTA member institutions and their representatives at both local and foreign coordination meetings and conferences.

Figure 2
The Science and Technology Coordinating Council-Committee on Space Technology Applications: annual budget (Philippine pesos)



9. Possible areas of research and development

44. The framework for the establishment of programmes hinges on the use of space technologies for sustainable development. In essence, that framework has the prime objectives of sharing information and expertise as well as minimizing redundancy of effort, conserving human and financial resources and maximizing productivity in the utilization of space technologies for development.

45. The following areas are suggested for consideration.

(a) Establishment of a spatial information exchange infrastructure

46. Steps toward the establishment of a national infrastructure for geospatially referenced data have been in the works for several years now. The initiatives of the Inter-Agency Task Force on Geographic Information of the Office of the President reflect this objective of government towards the establishment of a spatial information exchange infrastructure, data integration and standardization.

47. On the meteorological front, PAGASA plans among other things to expand its observation or data collection and exchange networks through the establishment of regional service centres, to improve its telecommunications network and to procure Doppler radars, advanced astronomical equipment and facilities. The agency has partly implemented those activities through foreign-assisted projects and its regular annual appropriations.

(b) Continuing complementary research and development on the application of space technologies to address environmental issues in the Philippines

48. The following major research programmes, composed of modular projects and activities, will be pursued:

(a) Tropical cyclone forecasting and warning research system;

(b) Severe weather forecasting and warning research system;

(c) Quantitative precipitation and flood forecasting research programme;

(d) Long-range weather forecasting programme;

(e) Climate/agro-meteorological applications and climate change research programme;

(f) Hazard analysis, environmental impact assessment and disaster management/mitigation research programme;

(g) Astronomical research programme.

49. These programmes are aimed principally at improving the meteorological and hydrological services of PAGASA, in particular with respect to severe weather, tropical cyclone and flood forecasting and warning. Also, the programmes will enhance the agency's competence in monitoring and prediction of El Niño/La Niña, specialized weather services for agriculture, marine meteorology and oceanography, aviation meteorology, climate change and global warming issues, disaster preparedness and mitigation and astronomy and space science.

50. Most of these programmes will use data and information from remote sensing satellites and Earth-based stations. At present, the tracking and prediction of

tropical cyclones largely makes use of satellite images and grid-point value data that are accessed from the Regional Specialized Meteorological Centre via the Internet. The images and the vertical sounding of the atmosphere from ground receiver of the National Oceanic and Atmospheric Administration of the United States can be utilized for thunderstorm and severe weather prediction and for quantitative precipitation and flood forecasting.

51. The monitoring and prediction of El Niño/La Niña relies on remotely sensed sea surface temperature in the Pacific Ocean and computer-based global climate models that produce long-range (up to one year) forecasts of sea surface temperature and area-by-area rainfall distribution.

52. Research in astronomy will involve studies of observational data from a 45-cm telescope, with a charge coupled device camera, a photoelectric photometer and a spectrograph. The telescope and its accessories will be used for photography, measurements and recording of faint light or electromagnetic fields from celestial objects. Data from the Hubble space telescope will also be used in these studies.

(c) Implementation of collective data acquisition through the establishment, operation and maintenance of ground receiving stations

(d) Research and development on data reception and processing systems for remote sensing and telecommunications applications

53. Establishment of satellite-based Internet and other networking protocols. The Philippines has recently joined the Asian Internet Interconnection Initiative or AI3 project. The AI3 project is a Japanese research initiative whose aim is to build a test-bed for networking research and experimentation in Asia by providing country partners with free access to the JCSAT-3 satellite transponder, a key part in the AI3 networking test-bed.

54. Research experiments have been and are still being conducted in the areas of Internet Protocol Version 6 (IPv6) implementation and experimentation, multicast transmission by image processing satellite data traffic analysis, Ku-band link testing, video conferencing, satellite video broadcasting and distance learning. Many of the results of these experiments, in particular for satellite video broadcasting, satellite video conferencing and distance learning, are very significant and applicable to the Philippines.

55. Asymmetry of the path is perhaps the biggest problem with IP multicast over satellite. The problem is mostly eliminated by content providers scheduling transmission at a time when they know there are going to be receivers. Therefore, protocols like the Internet Group Management Protocol are not necessary and the multicast is essentially reduced to a satellite-based broadcast. In the future, the use of on-demand transmission may necessitate the re-working of some multicast protocols and some research is being done in that area.

56. Establishment of community telecentres. One of the recommendations of the Philippine Information Infrastructure Policy Study is the expansion of the public calling offices into community telecentres. Parallel initiatives are in the pipeline, under the aegis of the University of the Philippines–Open University, known as community teleservice centres. A community teleservice centre terminal is a shared information and communication facility for people in rural and isolated areas and is used as a means of improving access to telematics in remote areas. Such centres

provide information technology and telecommunications services, user support and training for the population of a community that cannot afford such facilities on an individual basis and/or do not have the skills to use such tools. The set of applications supported by such centres varies considerably in its simplest form. Widely introduced in developing countries, it may provide public telephones and fax services, electronic mail, access to the Internet and other electronic databases, as well as tele-training and telemedicine.

57. Developing a satellite-based disaster relief and emergency medical service at a very affordable cost. The communications system would require arranging bandwidth on demand for a two-way satellite-based multimedia platform to permit physicians to communicate with the disaster site, monitoring the emergency response.

58. Acquisition of orbital slots. The Government of the Philippines, through the Department of Transportation and Communications, will continue to undertake activities to acquire orbital slots for the country. Subsequent orbital slot applications will include the acquisition of additional orbital slots and/or frequency bands, such as Ka-band, X-band and L-band, to allow the country's satellite operators to provide multiple telecommunications services.

59. Establishment of broadband global mobile personal communications by satellite services in the Philippines. The Department of Transportation and Communications issued Department Circular No. 98-01, entitled "Global mobile personal communications by satellite (GMPCS) policy," allowing duly enfranchized telecommunications entities having appropriate authorizations from the National Telecommunications Commission to offer GMPCS services in the Philippines, subject to existing laws, rules and regulations.

60. Conduct of collaborative research with Asian countries on ultra-high density recording Sat-Co/data relay experimental systems in the Philippines. This research programme will include experiments on and analysis of the impact on satellite systems of Philippine geographical conditions utilizing Ka-band frequencies and transmitting/receiving at asynchronous transfer mode platform.

61. Implementation of the government transponder utilization plan. This activity involves the conduct of a comprehensive feasibility study leading to infrastructure implementation. The conduct of a feasibility study aims to determine if the implementation of the plan can be expected to provide a satisfactory return for the Philippines. A favourable result will lead to a decision for the Government to invest in the project, thereby realizing the objective of the transponder plan, which is to optimize fully the use of the transponders granted to the Government.

(e) Development of expertise in integration of satellite design and facilities

(f) Acquisition and development of capabilities in satellite subsystems, that include but are not limited to sensors and payloads, power, telemetry and control

(g) Development of downstream applications of global and other satellite-based positioning systems for various navigational and civil applications

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Committee on the Peaceful Uses of Outer Space

Implementation of an integrated, space-based global natural disaster management system

Note by the Secretariat

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I. Introduction

1. At its forty-third session, the Committee on the Peaceful Uses of Outer Space agreed that, in accordance with the first year of the three-year work plan entitled "Implementation of an integrated, space-based global natural disaster management system", the Scientific and Technical Subcommittee at its thirty-eighth session should review the types of natural disasters being faced and the extent of the application of space-based services being utilized for their mitigation.[1]

2. The Committee also took note of the agreement of the Working Group of the Whole of the Scientific and Technical Subcommittee that the Secretariat should invite Member States and international organizations to submit to the Subcommittee at its thirty-eighth session information on the subject to be discussed at that session (A/AC.105/736, annex II, para. 41). Pursuant to the recommendation of the Committee, in a note verbale dated 26 July 2000, the Secretary-General requested Governments and international organizations to furnish information on the subject by 31 October 2000 so that it could be submitted to the Subcommittee at its next session. The present document contains the information received from Member States and international organizations by 24 November 2000. Information received subsequent to that date will be included in an addendum to the present document.

3. A report of the Secretariat entitled "Implementation of an integrated, space-based global natural disaster management system" is being issued as a separate document (A/AC.105/758).

II. Replies received from Member States

Brazil

[Original: English]

1. The Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) of the Instituto Nacional de Pesquisas Espaciais (INPE) routinely records images of the NOAA-N satellite of the National Oceanographic and Atmospheric Administration (NOAA) of the United States of America, the NOAA Geostationary Operational Environmental Satellite-E (GOES-E) and Meteosat satellites. Satellite imagery is a useful complement for weather and climate monitoring. Other variables of meteorological and environmental interest are assessed, including temperature and humidity, wind speed, sea surface temperature, solar radiation, vegetation indexes and fires. The information described is released through the CPTEC home page (www.cptec.inpe.br) for public use. Concerning disaster mitigation, two specific activities may be mentioned: monitoring of draughts; and burning mass detection.

1. Monitoring of droughts

2. The social impact of droughts affecting large areas of north-eastern Brazil can at least be mitigated if information on water stress is managed properly. The PROCLIMA Project at CPTEC performs daily assessment of soil water deficit, based on surface data and daily solar irradiation from GOES-8 visible imagery, using a model developed at INPE. This method allows monitoring of an area

extended over more than 1.5 million km^2. Geographic information systems (GIS) allow results from monitoring to be applied to management decisions by local and federal authorities. There are plans to extend this project to southern Brazil, where drought conditions in La Niña years usually have economic and social impacts.

3. The normalized difference vegetation index (NDVI) and the Global Environmental Monitoring Index (GEMI), based on the advanced very high resolution radiometer (AVHRR) sensor on the NOAA-14 satellite, are being assessed over Brazil. Previous cloud masking is performed. Comparison of index performance for identification of vegetation characteristics in selected areas is in development. These results will be valuable for the monitoring not only of soil water deficit but also of crop stress.

2. Burning mass detection

4. Forest fires may be of natural or anthropogenic origin. For more than a decade INPE has performed activities of fire monitoring using channel 3 of AVHRR/NOAA satellites. Combined with CPTEC weather forecasting and information about weather events occurring over the past week (mainly precipitation), a fire risk index has been defined. A comparison is being made between AVHRR-based hot points and GOES-8 data (channels 2 and 4) for the diurnal period. All this information is organized in GIS and is being released for management by local and federal authorities.

5. After the wildfire that affected approximately 12,000 km^2 (1,200,000 hectares) of primary forest in the state of Roraima, Brazil, in early 1998, the Government of Brazil requested that a concerted programme be initiated, based on satellite data. The decentralized dissemination of daily information about the persistence of (fire) hot spots, as detected by the AVHRR sensor on board the meteorological satellites NOAA-12 and NOAA-14, includes the type of land cover being affected by the burn, information on precipitation, accumulated over the previous 10 days, as well as the precipitation forecast, and the daily risk map (which integrates information about type of vegetation, soil retention capability, incidence of hot spots and precipitation). This dissemination of information to environmental institutions in selected Amazonian states has been responsible for monitoring the traditional burns in the region to detect any danger to nearby forested areas.

6. The results from this programme have enabled the environmental agency in Brazil (Instituto Brasileiro do Meio Ambiente Escritório Regional de Barreiras (IBAMA)) to request that no official authorization to burn be conceded when there is potential danger of wildfires, especially during adverse climatic conditions such as severe drought. The initiative is one component of a much larger programme (PROARCO) that includes environmental education, training to combat wildfires and wide dissemination of information. Whenever there is a danger of forest fires, local (state or municipal) control agencies are alerted by IBAMA and mobilize their staff to prevent the expansion of a possible uncontrolled burn in a forested area. All the information generated by this programme can be assessed and manipulated in a Geographic Information System called SPRING-Web, which was developed at INPE and can be used in a simple computational setting such as Windows or UNIX. All information about the programme can be accessed via the World Wide Web (www.das.inpe.br or www.cptec.inpe.br).

India

[Original: English]

1. Introduction

1. It is estimated that, by the turn of the century, 50 per cent of the world's population will be concentrated in urban agglomerations with a high population density and minimum basic facilities for disaster management and mitigation. The human suffering and economic loss in the event of a disaster will be many times that in rural areas. The Indian land mass, covering over 3 million km^2, has widely varying topography, including coastal and mountainous areas and plains, with tropical and extra-tropical climate systems. The land is affected by several natural hazards such as floods, cyclones, landslides, droughts, earthquakes and forest fires (see table 1). India has a large area susceptible to seismic activity, and several occurrences have been recorded. Tropical cyclones developing in the Bay of Bengal and the Arabian Sea affect the Indian coast with a frequency of 5-6 per year, occurring in the pre- and post-monsoon seasons.

Table 1
Summary of major disasters and their impact

Disaster	*Year*	*Region*	*Impact lives lost*
Earthquakes	1905	Himachal Pradesh	20 000
	1934	Bihar-Nepal	14 000
	1950	Assam	1 500
	1963	Kashmir	Hundreds
	1967	Koyna	200
	1988	Bihar-Nepal	1 003
	1991	Uttarkashi, Uttar Pradesh	715
	1993	Maharashtra	7 928
	1997	Jabalpur	38
Floods	1981	All of India	1 376
	1985	All of India	1 804
	1991	All of India	1 145
	1994	All of India	1 511
	1997	All of India	929
Cyclones	1737	West Bengal	300 000
	1822	Barisal	20 000
	1864	West Bengal	50 000
	1876	Backerganj	200 000
	1942	Contai, West Bengal	15 000
	1971	Paradeep	10 000
	1977	Chirala, Arunchal Pradesh	10 000
	1999	Orissa	10 000

Sources: Government of India, Ministry of Urban Development, Report of Expert Group; and Government of India, Ministry of Water Resources, Central Water Commission.

2. Floods occur during the monsoon season because of heavy rainfall in major river systems; they affect over 65 million hectares. If the monsoon does not occur, there may be severe drought conditions and crop damage; the reduction in crops can be of the order of 10-15 million tons. Sub-Himalayan and north-west India are prone to earthquakes. The mountainous areas in the Himalayas and other parts of the country are affected by landslides, many times compounded by urbanization of these fragile areas.

3. The basic responsibility for managing disasters in India belongs to the state governments concerned. The role of national Government is supportive, in terms of supplementing physical and financial resources and complementary measures in sectors such as transportation, disaster warning and food storage. The overall policy and guidelines are provided from time to time by the national Government. The Government of India has assigned to the Department of Agriculture and Cooperation the responsibility for coordinating activities related to natural disasters. The Central Relief Commissioner at the Department is the focal point for interaction with state government and central agencies and departments. Non-governmental organizations are also involved during development of policies and plans.

2. The role of space in disaster management

4. The essential requirements of disaster management are to provide reliable and timely information during the disaster phase and analyse vulnerability to enable preventative measures. Space has a key role to play in terms of providing monitoring capability over areas affected by disasters and supporting emergency communication requirements. One of the important objectives of the Indian space programme is to provide services for disaster management. The Indian programme, encompassing the geostationary Indian National Satellite (INSAT) system and the polar-orbiting Indian Remote Sensing Satellite (IRS) system, as well as a few research satellites, provides data and observations on meteorology, land and oceans, as well as satellite-based communication services (see table 2).

Table 2
Geostationary and polar-orbiting satellites

Satellite	*Sensors*	*Parameters*
Geostationary orbit		
INSAT-1	Visible and thermal infra-red (TIR)	Clouds, cloud motion vectors (CMBs) (2 levels), sea surface temperature (SST), quantitative precipitation estimate (QPE), Outgoing Longwave Radiation (OLR)
INSAT-2	Visible, TIR, water vapour (WV) and Charge Coupled Device (CCD)	Clouds, CMVs (3 levels), SST, WV image, QPE and OLR
INSAT-3[a]	Visible, TIR, WV, Sounder CCD	Clouds, WV image, SST and OLR
METSAT[a]	Visible thermal, Sounder, and WV	SST, clouds, CMVs, WV, mesoscale and temperature and humidity profiles

Satellite	*Sensors*	*Parameters*
Polar orbit		
NOAA	Advanced very high resolution radiometer (AVHRR) (5 channels), high resolution infra-red radiation sounder (HIRS), Microwave Sounding Unit (MSU) and stratospheric sounding unit (SSU)	Cloud cover, water, 15-layer mean temperature, SST and vegetation index
IRS-P3	Modular Optoelectronic Scanner (MOS) (13 chan-nels)	Ocean colour and aerosol
IRS-P4	Multifrequency Scanning Microwave Radiometer (MSMR) (4 channels) and Ocean Colour Monitor (OCM) (8 channels)	Liquid water content, ocean surface wind, SST, WV, ocean colour and aerosol
IRS-IC/ID	Linear Imaging Self Scanner (LISS) 3, Panchromatic Camera (PAN) and Wide Field Sensor (WiFS)	Land use, land cover, infrastructure, inundation and vegetation, among other things

[a]Sensors under finalization.

5. The data from INSAT and IRS satellites are being utilized by several government agencies such as the India Meteorological Department, the Forest Survey of India, the Geological Survey of India and state remote sensing centres other than the Indian Space Research Organization (ISRO). Severe weather monitoring and forecasting over the Indian land mass is dependent to a large extent on imagery and data from INSAT. The data on parameters such as land use, land cover, vegetation, soil types, water potential and drainage are useful in vulnerability analysis.

3. Operational use of space inputs

6. Over the past two decades, the operational uses of satellite data and services have emerged in certain areas of disaster management. The areas are cyclone monitoring, cyclone warning and the International Satellite System for Search and Rescue (COSPAS-SARSAT) programme. In several other areas, the experimental phase of validation of space inputs is in progress.

(a) Cyclone forecasting and monitoring

7. The India Meteorological Department has a well-established network of observatories for monitoring weather and meteorological parameters over the Indian land mass. Data from INSAT are used to detect the genesis of weather systems in the Bay of Bengal and the Arabian Sea and to monitor their development continuously. Following Dvorak's classification of satellite imagery with respect, for instance, to central dense cloud mass and curved bands, the cyclone is assessed for its intensity. In addition to INSAT data, data from cyclone detection radars at several coastal locations on the east and west coasts are used to observe and monitor

cyclones and cyclone landfall. The India Meteorological Department issues cyclone warning messages on the location, intensity and probable track from six cyclone warning centres. The sector scan mode, which repetitively covers an area of interest, is used to acquire frequent satellite data over the cyclonic region. The Department is also pursuing research on prediction models to give storm surge assessments.

(b) Dissemination of warnings

8. A unique system developed by ISRO, the Cyclone Warning Dissemination System (CWDS), is used for providing warnings to coastal areas. CWDS has the capability to alert specific areas that are likely to be affected by a cyclone. CWDS operates through INSAT and has a receiver with specific codes. The Area Cyclone Warning Centre uplinks the warning messages (in the local language) along with the area code to alert the specific locations. The CWDS receivers are kept in the office of the district administrator for direct dissemination to the authorities. Over 250 receivers are operating in the east and west coastal areas.

(c) International Satellite System for Search and Rescue programme

9. Significant developments in satellite communication capabilities and the availability of low-cost terminals have led to the design of an international system for search and rescue, the COSPAS-SARSAT system. The system assists in disaster detection and position location over land or sea through the use of a beacon communication facility at the assigned frequency of 406 MHz to alert rescue coordination centres. INSAT-2A provides support to COSPAS-SARSAT and three ISRO stations operate as local terminals and service the Indian Mission Control Centre. The Centre provides services to several neighbouring countries.

4. Areas of research and development in space applications

10. Efforts are under way to assess the potential of space inputs in other areas of disaster management, with a view to eventually developing operational uses for them.

(a) Flood monitoring and damage assessment

11. With the availability of satellite data from satellites such as IRS, the European remote sensing satellite (ERS) and RADARSAT, monitoring of major floods has been taken up by the National Remote Sensing Agency in Hyderabad. Flood inundation maps are prepared using satellite data and provided to the Central Water Commission and concerned state government agencies. One of the requirements of the user is to assess the damage caused by floods to crops and infrastructure. A pilot study has been carried out for nine flood-prone districts in Assam. Information on the water level during the flood season was obtained from monitoring stations of the Central Water Commission. A digital database was created for the districts with layers on land use and land cover, administrative boundaries (in villages and districts) and socio-economic data. Damage was assessed by intersecting flood layers, obtained from near real-time satellite data, with Geographic Information System (GIS) layers on affected areas and administrative boundaries. Efforts were made to develop empirical models relating water level and rainfall to inundation of crop area.. Limited validation of the results with field-level functionaries showed conformity with ground reality. Efforts were also made to use NICNET connectivity

to disseminate information on flood levels to state centres. The study has underlined the potential of space data to provide vital information on flood damage (including spatial coverage) at the village level for use by the state government.

12. The pilot project identified the following technological problems with microwave data:

(a) Turnaround time limitations in generation and analysis of data;

(b) Lack of detailed contour information and digital elevation models (DEMs);

(c) Gaps in critical data (station network and observations);

(d) Lack of a reliable historic database for model development;

(e) Lack of an updated database on village and district boundaries.

(b) Drought monitoring

13. Owing to abnormalities in atmospheric circulation, the total monsoon precipitation over the Indian subcontinent is subject to both spatial and temporal variations that lead to drought when precipitation is low. The major drought-prone areas are in the arid and semi-arid regions of Rajasthan, Gujarat, West Bengal, Orissa and Andhra Pradesh. The 1987 drought, for example, had a lasting impact on almost a third of the population of the country and resulted in drinking water scarcity in about 93,000 villages.

14. Based on the capability of satellite data to monitor vegetation conditions, the National Agricultural Drought Assessment and Monitoring System (NADAMS) was initiated by the Department of Space with support from the Department of Agriculture and Cooperation. The project uses daily NOAA/AVHRR data to produce vegetation index maps depicting vegetation cover and conditions at the district and subdistrict levels. The drought bulletin prepared under the project provides a vegetation condition map and an assessment of agricultural drought conditions based on comparison with the previous year. Since 1998, when Wide Field Sensor (WiFS) (188 m) data from IRS-1C/1D became available, crop-specific quantitative assessment has been provided at the taluk/block/mandal level for Arunchal Pradesh, Karnataka and Orissa. Efforts are being made to integrate meteorological data with visibility information in order to assess the spatial and temporal inadequacies of rainfall at the critical crop stages and, subsequently, to assess crop status and conditions, leading to a quantitative evaluation of the impact of drought.

Drought combating and proofing

15. Poor and inefficient management of land and water resources over the years has resulted in serious concern for drought mitigation. The integrated approach of utilizing existing conventional data with satellite remote sensing data assumes great importance in enabling the development of operational methodologies in basic resource mapping and management to formulate long-term drought mitigation measures. The integration of remotely sensed data and conventional information through GIS has resulted in an integrated approach to drought mitigation aimed at evolving a set of action plans with emphasis on water resources, agriculture, land

management and fodder management. The location-specific action plans have been developed for several drought-prone districts, with emphasis on the following:

(a) Water harvesting through percolation tanks, ponds and check dams;

(b) Soil conservation through terracing and contouring;

(c) Afforestation, agroforestry and agro-horticulture;

(d) Fuel wood and fodder development;

(e) Sand-dune stabilization.

16. Several projects being coordinated by the Department of Space, with the collaboration of user agencies, contribute to long-term drought mitigation. They include:

(a) The Rajiv Gandhi Drinking Water Technology mission, for the preparation of maps on groundwater potential at the district level on the scale 1:250,000 for the entire country using multispectral satellite data. This has helped in the identification of better well sites for groundwater extraction;

(b) The Integrated Mission for Sustainable Development, to evolve action plans for combating droughts against the backdrop of the socio-economic conditions of the watershed: satellite-derived thematic information is integrated with socio-economic data to provide action plans for the development of food, fodder and water resources. The implementation of action plans have resulted in:

(i) Reduction of run-off loss by about 50 per cent;

(ii) A rise in the water level from 0.9 to 5 m due to check dams and percolation tanks;

(iii) An increase of between twofold and fivefold in agricultural productivity;

(c) Irrigation management using satellite data in selective basins, for the investigation of proposed irrigation development, the identification of poor performance distributories and the assessment of sediment loads in reservoirs.

(c) Landslide zonation

17. Satellite data are being used in conjunction with ground surveys to map landslide-prone areas in the Himalayan region and to assess the risk of landslides. Through an approach that involves weighting the geological, structural and geomorphological features, landslide risk is being assessed using GIS techniques.

(d) Database creation

18. To support disaster management, the design and development of digital databases for priority districts have been started by ISRO. Specifications, including modelling and a query-based interface, sources of information, standards to be followed with respect to the framework, structure and quality control and a plan for creation of the database, have been drawn up. The districts to be covered in the first phase have been identified as the cyclone-prone districts of Andhra Pradesh, Orissa and West Bengal and the flood-prone areas of Assam and Bihar. The GIS layers for the database have been identified as land use/land cover, administrative boundaries,

infrastructure, socio-economic data and locations of warning and relief centres. Subsequently, drainage, topography, geomorphology and soil layers will be added.

5. Constraints in using space data for disaster management

19. Some of the constraints that affect the operational use of space data for disaster management are:

(a) Limitations due to cloud cover and repetitivity;

(b) Considerable turnaround time for data analysis and the dissemination of information to end-users;

(c) Understanding and appreciation of the information communicated by the affected population, decision makers and planners;

(d) Inadequate supporting data such as databases, digital terrain models (DTMs), fine contour information and other models.

6. Conclusions

20. While extensive work has been carried out in India to utilize the potential of satellite data and services for disaster management, there is a long way to go before those services can be put into operation. Major constraints need to be overcome, for instance, ensuring satellite data availability, developing supporting infrastructure such as digital databases, DTMs and fine contour information and creating appropriate modelling support and communication links for the timely dissemination of information. Ultimately, the user acceptance and adoption of the technology need to be ensured.

Peru

[Original: Spanish]

1. El Niño phenomenon

1. Activities relating to the monitoring of flood impact zones and damage assessment are carried out using satellite images.

2. Automatic meteorological stations use satellites as retransmitters in order to obtain information and send it to processing centres.

2. Other flood risks

3. In the Peruvian jungle areas, satellite images are used for monitoring the major rivers. Use is also made of meteorological satellites.

3. Earthquakes

4. A seismological network uses satellites to obtain information and transmit it to the processing centres.

4. Frost/cold

5. Nationwide meteorological stations automatically send meteorological information to the processing centre by satellite. This is the most suitable method owing to communication difficulties caused by the terrain.

Philippines

[Original: English]

1. Introduction

1. The Philippines is a country frequently visited by natural disasters, including tropical cyclones, storm surges, typhoon floods, droughts, lahars, mudflows, earthquakes, El Niño and La Niña. For such disasters, space technology services and products are utilized, depending on the availability of data and the magnitude of the disaster.

(a) Typhoon and storm prediction

2. Weather conditions in the Philippines are monitored in real time by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). The geostationary meteorological satellite of Japan and the polar-orbiting satellite of the United States of America are routinely utilized for monitoring storm surges, floods, droughts and thunderstorms and in tracking tropical cyclones. The data and information obtained from those satellites are used in the preparation and provision of early warnings, advisories and bulletins, which initiate the national disaster preparedness programme when warranted. In addition to manned and automatic weather stations, the agency utilizes advanced very high resolution radiometer (AVHRR) images received through its ground receiving station to monitor the location of typhoons. Storm signal warnings are announced twice a day immediately after receiving the AVHRR satellite images, once in the morning and once in the afternoon.

(b) El Niño and La Niña

3. Using processed AVHRR satellite data, PAGASA is able to determine sea surface temperature. AVHRR images taken at different times and on different dates make it possible to monitor the movement of warm water on the ocean surface. Consequently, PAGASA is able to forecast when El Niño and La Niña will hit the Philippines and what parts of the country will be severely affected. This has resulted in the preparedness of the Government and the people for those two extreme climatic phenomena.

(c) Lahar and mudflow hazards from Mount Pinatubo

4. After the 1990 eruption of Mount Pinatubo, various optical images from Landsat Thematic Mapper (TM) and SPOT XS, taken on different dates, were utilized to determine the extent of damage caused by the eruption. Areas of pyroclastic material deposits were mapped using the images. Built-up areas that were under the threat of extreme lahars, mudflows and consequential flooding were identified using satellite imagery.

2. Volcanic eruptions and impacts of primary and secondary eruptive products

(a) Volcano eruption prediction and monitoring

5. Global Positioning System (GPS) technology is used for the monitoring of precursory ground deformation of active volcanoes (such as the Mayon and Taal volcanoes).

6. Satellite images, for instance, from weather satellites, are used to monitor volcanic activities such as the spatial and temporal dispersal of the eruption cloud.

(b) Volcanic hazards mapping

7. Space-based services are used to identify and map various volcanic deposits to produce deposit maps, volcano-geologic maps and assess potential hazards in the event of future eruptions. Satellite and radar images are used in mapping volcanic products and volcanic structures. The data gathered serve as input for the preparation of geologic maps and hazard maps for various eruptive products. Space-based images are especially useful in mapping in remote, inaccessible and socio-politically non-viable areas for ground-based surveys. Volcano hazard maps have been generated for several active volcanoes and are being utilized by government and non-government agencies in the preparation of volcano eruption disaster mitigation contingencies. Preliminary and rapid mapping of newly erupted volcanic products can be carried out using space-based data, if these are available. The delineated extent is then validated in the field. Application of GPS technology is very important in mapping out newly erupted volcanic deposits especially when the morphology of the volcano has been drastically changed (which was the case with the Mayon and Pinatubo volcanoes). Satellite technology provides digital data that can be easily integrated into the Geographic Information System (GIS), which can be manipulated to generate a variety of information on volcanic deposits, structures and processes for volcano hazard assessment. Elevation data from radar images have been used to generate preliminary digital elevation models (DEMs) for the Mayon volcano and the crater area of Pinatubo, which have been used for mapping and hazard assessment. The currently available topographic map for the Mayon volcano was prepared before 1984, and several eruptions have already occurred since then that have changed the topography of the volcano. The DEM for the Mayon volcano, based on radar images from 1996, served as a guide during field mapping of the 2000 eruption deposits. DEMs generated for the crater area of Pinatubo served as the basis for estimating the volume of water in the crater lake, which is important in assessing the flood or lahar hazard that could occur if the crater lake breached.

(c) Lahar mapping

8. Space-based services are used to map the distribution of potential lahar source materials and old lahar deposits and to delineate the possible extent of future lahars in active and potentially active volcanoes. Satellite and radar imageries are utilized to delineate the extent of pyroclastic flow deposits (potential source materials) and lahar deposits from past explosive eruptions of active and potentially active volcanoes in the Philippines in order to identify areas threatened by future occurrences of lahars. Satellite and radar images are used to identify geomorphic

changes in watershed areas and river channels draining a newly erupted active volcano (such as the Mayon and Pinatubo volcanoes).

3. Earthquake hazards and active faults

(a) Active fault mapping

9. Space-based services are used to identify and characterize regional and local active faults in order to better assess earthquake-related hazards and risks. Space-based information, such as synthetic aperture radar (SAR) and Land Remote Sensing Satellite (Landsat) data, is utilized to a significant extent in the mapping of faults, since satellite scenes usually cover an area of several hundred square kilometres and therefore are very useful and effective in mapping large linear structures. Aerial photo interpretation, topographic analysis, drainage analysis and field investigation would later validate structures defined using satellite-based data. Considering the presence of numerous islands and mountain ranges in the Philippines, access to and utilization of satellite-based data can minimize fieldwork in far-flung and inaccessible areas. Active faults and potentially active structures can be mapped using space-based images (though with lower certainty) in areas in which the situation concerning peace and order is critical.

(b) Seismic hazard identification and mapping

10. Space-based services are used to map and identify areas affected and susceptible to earthquake-related hazards. Space-based information provides time-series images that allow identification and delineation of temporal variations of ground surface conditions used in the generation of geologic and seismic (landslide, liquefaction) hazard maps. Generated liquefaction susceptibility maps are being utilized by government and non-government agencies in preparation of disaster contingencies in the event of a major earthquake. Space-based images provide rapid documentation of the damage and impacts of major earthquakes, such as the landslides caused by the earthquake on Luzon on 16 July 1990.

Replies received from international organizations

Economic and Social Commission for Asia and the Pacific

[Original: English]

The Economic and Social Commission for Asia and the Pacific (ESCAP) has a Regional Working Group on Meteorological Satellite Applications and Natural Hazards Monitoring. The members of the Working Group are working together to develop a self-sustaining mechanism for promoting regional cooperation on meteorological satellite applications and natural hazard monitoring and to formulate and implement collaborative meteorological satellite application projects relevant to natural disasters in the region. The major activities of the Working Group in the past were in human resource development and information exchange.

Food and Agriculture Organization of the United Nations

[Original: English]

1. In 1993, the Food and Agriculture Organization of the United Nations (FAO) established an in-house task force on the coordination of emergency activities of the Organization. The Emergency Coordination Group was established: (a) to ensure that coordinated action is taken by technical divisions concerned in responding to critical emergency situations identified by the Global Information and Early Warning System (GIEWS); (b) to provide the mechanism for disaster preparedness and close monitoring of situations; (c) to ensure appropriate links and coordination between emergency and post-emergency action, including reconstruction, rehabilitation and longer-term development; and (d) to monitor the flow of financial resources for emergency activities. With the restructuring of the Organization that led to the reallocation of functions related to emergency assistance, the composition of the Emergency Coordination Group and its terms of reference were in August 1999 amended as follows.

2. In full consultation and with the support, as necessary, of the units concerned in the Organization, the Emergency Coordination Group will:

(a) Ensure coherent preventative action and systematic response from all the units concerned within FAO, through enhanced collaboration at all stages in the emergency, entailing both normative elements (establishing clear and practical guidelines and procedures) and operational elements (ensuring high levels of synergy between field operations at each stage);

(b) Ensure that FAO maintains a high profile and strong voice in the various inter-agency emergency-related consultative forums, that food and agriculture sector issues receive due attention and coverage and that action in the food and agriculture sector are given due priority in the formulation of emergency prevention, mitigation and rehabilitation policies and operations;

(c) Convene in the event of large-scale natural disasters and man-made emergencies, or economic crises, on the basis of early warning and other information, and ensure that coordinated action is taken;

(d) Arrange for action plans to be prepared for each stage of FAO interventions and monitor the progress of the Organization's response vis-à-vis the targets in the action plan, review in-house evaluations and draw lessons from past experience;

(e) Ensure that FAO liason offices in Geneva and New York, representatives and regional and subregional representatives are kept adequately informed and involved in action taken at headquarters and apprise them of the Organization's position in inter-agency forums;

(f) Identify the appropriate measures to strengthen the capacity of FAO for resource mobilization to ensure that its interventions are adequate and timely by defining a comprehensive strategy, monitoring actual resource commitments against appeals and increasing advocacy at the field level.

3. Specific FAO disaster-related activities, including the use of remote sensing, Geographic Information System (GIS) and related decision support tools, are described below.

1. Participation in the Inter-Agency Task Force for Disaster Reduction

4. To strengthen cooperation within the United Nations system, international organizations and non-governmental organizations concerned, FAO has actively participated in the work of the International Strategy for Disaster Reduction since its inception as a follow-up arrangement of the International Decade for Natural Disaster Reduction. FAO designated an organizational focal point for the Strategy and is among the eight United Nations agencies identified as the members of the Inter-Agency Task Force for Disaster Reduction. The organizational focal point participated in the meetings of the Task Force. FAO also provided both policy and technical contributions to the formulation of the framework for action for the implementation of the Strategy. In addition, FAO has also designated three senior technical officers as contact persons and provided substantive technical contributions to three working groups established by the Task Force on the following subjects: El Niño and La Niña, climate change and variability; early warning; and risk, vulnerability and disaster impact assessment.

2. Support to emergency planning: development of a disaster preparedness database under the United Nations Interim Mission in Kosovo administration

5. FAO, through its Emergency Coordination Unit in Pristina, is fully committed to adjust its agricultural assistance programmes in Kosovo to support the transition period from emergency to development. For this purpose, the Unit is involved in inter-agency dialogue and cooperation with local institutional counterparts in Kosovo, particularly the Department of Agriculture, Forestry and Rural Development under the United Nations Interim Mission in Kosovo (UNMIK). As part of that process, FAO has established a food security surveillance unit under a project funded by the United States of America that should ultimately fall under the responsibility of UNMIK. It is hoped that the project can be extended for a second year, with a broadening of its focus to include food security surveillance in neighbouring areas such as Serbia and Montenegro and countries such as Albania. In addition, FAO undertook a mission to review mechanisms to assist the Office for the Coordination of Humanitarian Affairs of the Secretariat with its Humanitarian Community Information Centre in Pristina and is developing a proposal for the Office for the Coordination of Humanitarian Affairs on the creation of a disaster preparedness database to be used as part of an inter-agency response mechanism. At a more global level, such a database would be aimed at supporting the response of the international community to human and natural disasters in affected and at-risk regions worldwide.

6. FAO is also participating in a new initiative launched by the Secretariat and members of the Geographic Information Support Team (GIST) to increase data sharing among United Nations missions by generating agreed standards for geo-referenced data. The areas of cooperation are being developed in various places, from Kosovo to the Horn of Africa. The database developed by FAO under its Land Cover Map and Geodatabase for Africa (Africover) project has already proved useful for emergency planning and disaster preparedness. FAO is ready to share its

expertise and information on the Programme Management Information System (ProMIS) in Afghanistan, an integrated system for emergency and rehabilitation planning.

3. Development of databases and handbooks for food security and sustainable agriculture

7. In cooperation with stakeholders concerned, FAO is providing operational service on environmental information through an Advanced Real Time Environmental Information Monitoring System using satellite remote sensing data. A database on agricultural disasters, including systematic and quantitative descriptions of causal factors, is being developed in FAO. FAO has also developed guidelines for rapid estimation of the impact of geophysical disasters on agriculture, using new and emerging Earth observation technology in combination with standard methodology. Through its normative programmes, FAO has also been developing baseline information for disaster prevention and monitoring, including the integrated use of GIS, remote sensing and decision support tools for vulnerability mapping to identify areas vulnerable to natural hazards and to provide assistance to its efforts to prevent natural disasters relating to food security and sustainable agricultural development. FAO has also recently initiated a technical handbook series on its emergency activities, commencing with six pamphlets on its contributions at each phase of the emergency sequence.

World Meteorological Organization

[Original: English]

The World Meteorological Organization (WMO) is very active in the detection and mitigation of natural disasters. Indeed, most WMO members have national mandates in that area. The WMO secretariat has focused its efforts on providing support for the detection and mitigation of natural disasters through its active participation in the International Strategy for Disaster Reduction. One small but shining example of the contribution made by WMO members to natural disaster reduction is the space-based Global Observing System of WMO that has been an integral part of its World Weather Watch from the very inception of the satellite.

International Astronomical Union

[Original: English]

The International Astronomical Union (IAU) welcomes the initiative by the Committee on the Peaceful Uses of Outer Space on space-based global natural disaster management systems. While most natural disasters studied by such systems are not of an astronomical nature, IAU wishes to point out the relevance of such systems for the timely detection of near Earth objects (minor planets and comets presenting a non-zero probability of an impact on Earth at some future time). Such objects, residing wholly or mostly inside the orbit of the Earth, are basically seen only in daytime and therefore invisible from the ground; space observations are required to detect them. IAU members study those issues as part of their regular duties in a variety of research organizations, and IAU therefore primarily intends to

work with interested delegations and agencies rather than present independent programmes on those issues.

Notes

[1] *Official Records of the General Assembly, Fifty-fifth Session, Supplement No. 20* (A/55/20), para. 119.

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Committee on the Peaceful Uses of Outer Space

Preliminary review of international documents relevant to the safety of nuclear power sources in outer space

Report by the International Atomic Energy Agency

I. Introduction

1. At its forty-third session, held in Vienna from 7 to 16 June 2000, the Committee on the Peaceful Uses of Outer Space noted that, in accordance with General Assembly resolution 54/67, the Scientific and Technical Subcommittee had continued its consideration of the item relating to the use of nuclear power sources in outer space. The Committee noted that, in accordance with the four-year work plan adopted by the Subcommittee at its thirty-fifth session (A/AC.105/697 and Corr.1, annex III, appendix), the Subcommittee had identified terrestrial processes and technical standards that might be relevant to nuclear power sources, including factors distinguishing nuclear power sources in outer space from terrestrial nuclear applications. The Committee also noted that the Subcommittee, at its thirty-seventh session, had reconvened the Working Group on the Use of Nuclear Power Sources in Outer Space. The Committee noted the discussions of the Subcommittee and its Working Group on the Use of Nuclear Power Sources in Outer Space, as reflected in the report of the Subcommittee and in the report of the Working Group (A/AC.105/736, paras. 75-83 and annex III).

2. In the report of the Working Group to the Subcommittee at its thirty-seventh session (A/AC.105/736, annex III, para. 6), the following international documents that might be relevant to the safety of nuclear power sources in outer space were identified:

(a) The provisions of the Convention on Nuclear Safety,[1] the Convention on Early Notification of a Nuclear Accident[2] and the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency;[3]

(b) The recommendations of the International Commission on Radiological Protection;

(c) The relevant Safety Series publications of the International Atomic Energy Agency (IAEA);

(d) The reports of the United Nations Scientific Committee on the Effects of Atomic Radiation.

3. The Working Group agreed that a review of those documents should be carried out within the context of the second year of its work plan in order to identify with more specificity those documents or parts of documents that might be of particular relevance to nuclear power sources in outer space. The Working Group welcomed the IAEA proposal to conduct such a preliminary review of the documents and requested IAEA to report on the matter at the thirty-eighth session of the Scientific and Technical Subcommittee, in 2001.

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4. The present report by IAEA to the Subcommittee at its thirty-eighth session is in response to that request.

II. Preliminary review of the identified documents

5. IAEA has been instrumental in the development of what is now widely recognized as a global safety culture for all applications of radiation and radioactive materials, comprising three elements: legally binding intergovernmental agreements; internationally agreed safety standards; and provision for the application of those standards.

A. Binding intergovernmental agreements

6. Three conventions are potentially relevant to the safety of nuclear power sources in outer space.

7. The Convention on Early Notification of a Nuclear Accident (the Early Notification Convention) entered into force in October 1986. It has 84 contracting parties (81 States and three international organizations).[4] The facilities and activities to which the Convention relates include, inter alia, "any nuclear reactor wherever located" and "the use of radioisotopes for power generation in space objects." The Convention applies in the event of any accident involving any such facility or activity under the jurisdiction or control of a State Party "from which a release of radioactive material occurs or is likely to occur and which has resulted or may result in an international transboundary release that could be of radiological safety significance for another State." In the event of such an accident, the relevant State party shall "forthwith notify ... those States which are or may be physically affected ... of the nuclear accident, its nature, the time of its occurrence and its exact location where appropriate" and "promptly provide [those] States ... with such available information relevant to minimizing the radiological consequences in those States, as specified in article 5."[5] Each State party is also required by the Convention to make known to the other States parties "its competent authorities and point of contact responsible for issuing and receiving the notification and information referred to". In each case, States parties may provide notification and information directly or through IAEA. In practice, IAEA is normally used as an intermediary.

8. All of the States operating nuclear power sources in outer space are parties to the Early Notification Convention. Any accident involving such a source that could lead to radioactive material re-entering the Earth's atmosphere would therefore be potentially within the scope of the Early Notification Convention.

9. The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention) entered into force in February 1987. It has 79 contracting parties (76 States and three international organizations).[4] The Convention requires the States parties to "cooperate between themselves and with the International Atomic Energy Agency ... to facilitate prompt assistance in the event of a nuclear accident or radiological emergency to minimize its consequences and to protect life, property and the environment from the effects of radioactive releases." Although many of the specific obligations concern the provision of assistance by States parties to other States parties, the Convention requires IAEA to "respond, in accordance with its Statute and as provided for in this Convention, to a requesting State Party's or *a Member State's* request for assistance in the event of a nuclear accident or radiological emergency" (emphasis added).

10. In addition to the reactive functions set out in the Assistance Convention, the States parties in article 5 request IAEA:

(a) To collect and disseminate information concerning experts, equipment and materials that could be made available in the event of an emergency and on relevant methodologies, techniques and research findings;

(b) To assist States on request in preparing emergency plans and legislation and in developing training or environmental monitoring programmes.

Again, IAEA is requested to perform those functions in relation to Member States as well as States parties.

11. The Convention on Nuclear Safety entered into force in October 1996. It has 53 contracting parties (52 States and the European Atomic Energy Community (EURATOM)). It is somewhat different in nature from the Early Notification Convention and the Assistance Convention, in that its main focus is on encouraging contracting parties to pursue agreed

nuclear safety objectives by fulfilling specific safety obligations at the national level. The international dimension takes the form of peer review: each contracting party is required to report periodically on the steps it has taken with regard to the specific obligations set out in the Convention, and those reports are reviewed by the other contracting parties.

12. The scope of the Convention on Nuclear Safety is explicitly restricted to land-based civil nuclear power plants and associated on-site handling, treatment and storage facilities. The Convention does not therefore apply to nuclear power sources in outer space, and contains no provision for reporting on or reviewing safety measures taken in relation to such sources. Nevertheless, the safety objectives and, where relevant, the specific safety obligations set out in the Convention may still be applicable to some extent. In particular, it might be difficult for States that have agreed to be bound by the Convention on Nuclear Safety to argue that the nuclear safety principles embodied in the Convention need not be applied to certain facilities or activities solely because they do not fall within the formal scope of the Convention.

B. Internationally agreed safety standards

13. IAEA is unique among international organizations concerned with nuclear energy or radiation issues in having a statutory function to "establish or adopt ... standards of safety for protection of health and minimization of danger to life and property".[6]

14. IAEA safety standards fall into three categories:

(a) Safety Fundamentals, which present basic objectives, concepts and principles of safety and protection in the development and application of nuclear energy for peaceful purposes;

(b) Safety Requirements, which establish the requirements that must be met to ensure safety;

(c) Safety Guides, which recommend actions, conditions or procedures for meeting safety requirments.

15. Five broad areas of safety covered by IAEA safety standards ae as follows:

(a) Nuclear safety: the safety of nuclear installations;

(b) Radiation safety: radiation protection and the safety of radiation sources;

(c) Waste safety: the safety of radioactive waste management;

(d) Transport safety: the safety of transport of radioactive materials;

(e) General safety: those issues common to two or more of the above-mentioned safety areas, such as legal and governmental infrastructure, emergency preparedness and response and quality assurance.

16. In the area of nuclear safety, the Safety Fundamentals publication entitled *The Safety of Nuclear Installations*,[7] sets out the basic objectives, concepts and principles for ensuring safety. In describing the scope of the publication, it is stated that: "These principles, since they are fundamental in nature, are applicable to a broad range of nuclear installations, but their detailed application will depend on the particular technology and the risks posed by it." Existing IAEA safety standards in the Safety Requirements and Safety Guides categories specifically address either nuclear power plants or research reactors. It may therefore be concluded that the general principles derived from the Safety Fundamentals could be applicable to the safety of nuclear power sources in outer space, in particular nuclear reactors, but that the more detailed Safety Requirements and Safety Guides are unlikely to be useful.

17. The radiation safety standards are set forth in the Safety Fundamentals publication entitled *Radiation Protection and the Safety of Radiation Sources*[8] and in *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources*[9]—commonly referred to as the Basic Safety Standards—which have the status of Safety Requirements. Both sets of standards are sponsored by IAEA and five other international organizations.[10] The publications set out, respectively, the basic objectives, concepts and principles of radiation protection (controlling exposure due to radiation sources) and radiation safety (keeping radiation sources under control and preventing accidents) and the requirements necessary to comply with those principles. Of particular relevance in the context of nuclear power sources in outer space are the principles of and requirements for

both the safety of radiation sources and intervention. Intervention is a radiation protection term to refer to actions taken to prevent or reduce radiation exposure, for example, in the event of an accident that results in a radiation source being out of control, and to mitigate the consequences thereof. The principles of and requirements for intervention therefore underpin the more specific requirements and guidance for emergency preparedness and response.

18. In the general safety area, the safety standards on preparedness for and response to nuclear and radiological emergencies are currently being revised. It is envisaged that a Safety Requirements publication (sponsored by the Food and Agriculture Organization of the United Nations, the World Health Organization (WHO), IAEA and the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD), and two Safety Guides—covering, respectively, preparedness (sponsored by WHO, IAEA and OECD/NEA) and criteria for planning the response to an emergency—will be issued in 2002. Those publications will provide specific recommendations and guidance, building upon the general requirements of the Basic Safety Standards, in particular those related to intervention, and will supersede the existing safety standards specifically concerned with emergencies. In addition, a Safety Practice publication, entitled *Emergency Planning and Preparedness for Re-entry of a Nuclear Powered Satellite*,[11] was issued in the IAEA Safety Series in 1996. The publication provides examples of experience and good practice from Member States, but is not considered a safety standard of the Agency, since it does not specify requirements or recommendations.

III. Provision for the application of Agency safety standards

19. IAEA provides for the application of its safety standards in five main ways, as follows:

(a) Providing direct safety-related assistance to Member States, mostly through its technical cooperation programme;

(b) Fostering the exchange of safety-related information;

(c) Promoting education and training in safety-related subjects;

(d) Supporting safety-related research and development;

(e) Rendering, on request, a range of safety-related services.

20. In relation to the safety of nuclear power sources in outer space, information exchange may be the most significant function. In addition to the above-mentioned Safety Practice publication, IAEA has issued a number of publications providing information on specific issues relevant to radiological emergencies, such as the medical treatment of people accidentally exposed to radiation and countermeasures and recovery operations after an accident.

21. It should also be noted that a number of the IAEA activities discussed above in the context of the Assistance Convention, such as providing assistance, advice or training in the field of emergency planning, could also have been viewed as providing for the application of safety standards.

IV. Conclusion

22. Three binding intergovernmental agreements are potentially relevant to the safety of nuclear power sources in outer space. The following salient points regarding the agreements should be noted:

(a) The Convention on Early Notification of a Nuclear Accident entered into force in October 1986. All the States operating nuclear power sources in outer space are parties to the Early Notification Convention. Any accident involving such a source which could lead to radioactive material re-entering the Earth's atmosphere would therefore be potentially within the scope of the Early Notification Convention;

(b) The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency entered into force in February 1987. The Assistance Convention requires the States parties to "cooperate between themselves and with the International Atomic Energy Agency ... to facilitate prompt assistance in the event of a nuclear accident or radiological emergency to minimize its consequences and to protect life, property and the environment from the effects of radioactive releases." This would be applicable in the case of an accident involving nuclear power sources re-entering the Earth's atmosphere;

(c) The Convention on Nuclear Safety entered into force in October 1996. The Convention does not apply to nuclear power sources in outer space, and contains no provision for reporting on or reviewing safety measures taken in relation to such sources. Nevertheless, the safety objectives and, where relevant, the specific safety obligations set out in the Convention may still be applicable to some extent. That issue is further developed in the report prepared by the Chairman of the Working Group on the Use of Nuclear Power Sources in Outer Space under paragraph 7 of the report of the Working Group on its deliberations during the thirty-seventh session of the Scientific and Technical Subcommittee (A/AC.105/736, annex III).

23. In view of the IAEA Safety Series publications, and given that provision for the safety of nuclear power sources in outer space would involve both the prevention of accidents that could cause the radioactive material in the power source to be released and the protection of the population if such an accident were to occur, it follows from the above considerations that the IAEA nuclear safety standards would be relevant to the prevention of accidents related to nuclear reactors (that issue is also further developed in the report prepared by the Chairman of the Working Group under paragraph 7 of the above-mentioned report of the Working Group).

24. The radiation safety standards would cover the prevention of all other accidents that might lead to the dispersal of the radioactive material in the nuclear power source. The mitigation of the radiological consequences of any accident would be covered by safety standards on emergency preparedness and response. Three sets of circumstances would have to be considered: those prevailing before the launch, during the launch and during the operation of the nuclear power source in outer space. An additional report would then be necessary to address that aspect, taking into account the radiation safety standards as well as the Early Notification Convention and the Assistance Convention.

25. The foregoing conclusion covers the international documents listed above in paragraphs 2 (a) and (c) that might be relevant to the safety of nuclear power sources in outer space, as identified by the Working Group. During the preparation of such documents, IAEA takes account of the findings of the United Nations Scientific Committee on the Effects of Atomic Radiation, identified in paragraph 2 (d), and the recommendations of international expert groups, notably the International Commission on Radiological Protection, identified in paragraph 2 (b), and the International Nuclear Safety Advisory Group. However, new documents, recently published or in preparation, might also be relevant. One example, publication 82 of the International Commission on Radiological Protection, relating to the protection of the public in situations of prolonged radiation exposure, would be relevant in the case of an accident leading to widespread contamination and prolonged exposure of the public. The recently published documents should be considered in the additional report recommended above.

Notes

[1] International Atomic Energy Agency, "Convention on Nuclear Safety" (INFCIRC/449).

[2] United Nations, *Treaty Series*, vol. 1439, No. 24404.

[3] Ibid., vol. 1457, No. 24643.

[4] The Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the World Meteorological Organization (WMO).

[5] Article 5 lists several specific items of information to be provided, relating to the accident, the release, protective measures and monitoring results.

[6] By article III, section A, paragraph 6, of its Statute, IAEA is authorized to "establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property (including such standards for labour conditions), and to providce for the application of these standards to its own operation as well as to the operations making use of materials, services, equipment, facilities, and information made available by the Agency or at its request or under its control or supervision; and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of atomic energy".

[7] IAEA, Safety Series No. 110 (STI/PUB/938) (Vienna, 1993).

[8] IAEA, Safety Series No. 120 (STI/PUB/1000) (Vienna, 1996).

[9] IAEA, Safety Series No. 115 (STI/PUB/996) (Vienna, 1996).

[10] ILO, FAO, WHO, the Nuclear Energy Agency of the Organization for Economic Cooperation and Development and the Pan American Health Organization.

[11] IAEA, Safety Series No. 119 (STI/PUB/1014) (Vienna, 1996).

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Committee on the Peaceful Uses of Outer Space

Activities of Member States for young people

Note by the Secretariat

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I. Introduction

1. In the report of its forty-third session,[1] the Committee on the Peaceful Uses of Outer Space took note of the agreement of the Working Group of the Whole of the Scientific and Technical Subcommittee that Member States and their relevant national institutions should be invited to report to the Subcommittee on the activities that they had carried out for young people (A/AC.105/736, annex II, para. 16).

2. Pursuant to the recommendation of the Committee, in a note verbale dated 26 July 2000, the Secretary-General requested Governments to submit any information on the above question by 31 October 2000 so that it could be submitted to the Scientific and Technical Subcommittee at its next session. The present document has been prepared by the Secretariat on the basis of information received from Member States by 24 November 2000. Information received subsequent to that date will be included in an addendum to the present document.

II. Replies received from Member States

Cuba

[Original: Spanish]

1. Space sciences

1. In honour of World Space Week 2000, the Hall of Cosmonauts at the Air Museum was remodelled and provided the venue for informal lectures and debates on astronomy and space sciences specially targeted at children and adolescents.

2. Distance learning

2. In 2000, a campaign was started to distribute televisions and video recorders to all primary and secondary schools in Cuba as part of a major effort to spread education and culture to all corners of the country.

3. Special television programming was organized with the aim of extending general knowledge and culture to the population at large, with various courses being included on a number of subjects, with five weekly slots at two different times of day.

[1] *Official Records of the General Assembly, Fifty-fifth Session, Supplement No. 20* (A/55/20).

Peru

[Original: Spanish]

The national institutions concerned with space technology regularly organize practical pre-professional courses on an annual basis for young university students as part of their training support. Support is also provided to space researchers under the programme conducted by the National Council for Science and Technology.

Philippines

[Original: English]

1. Philippine space activities for young people are conducted by two agencies.

1. National Mapping and Resource Information Authority

2. The National Mapping and Resource Information Authority (NAMRIA) conducts regular lectures, training courses, symposiums and exhibits in schools, universities and government and private offices. These activities are handled by highly trained NAMRIA resource speakers.

3. NAMRIA researchers participate in international symposiums such as the Asian Conference on Remote Sensing. The Philippines was the host country for the 1998 conference, which was spearheaded by the National Remote Sensing Center of NAMRIA.

2. Philippine Atmospheric, Geophysical and Astronomical Services Administration

4. The Astronomy Research and Development Section of the Atmospheric, Geophysical and Space Sciences Branch of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) conducts stargazing and telescoping sessions for students of various schools located in different parts of the country in order to promote astronomy and space science. It also organizes the Astro Olympiad, a contest in astronomy designed specifically for high school and college students, which aims to enhance the awareness of the general public, in particular of youth, in the science of astronomy.

5. Since the agency has only one planetarium, which is located in Quezon City on the island of Luzon, a mobile planetarium was acquired in order to bring astronomy to the countryside. PAGASA will also complete during 2001 the distribution of its newly acquired four Meade LX-200 telescopes to four local regional centres, which will undoubtedly enhance the knowledge of youth in astronomy and space science and, it is hoped, arouse their interest.

6. Lastly, in 2001 the Philippines will complete the installation of a 45-cm computer-based astronomical telescope, donated by the Government of Japan, which will be used mainly for observation and documentation of astronomical objects and phenomena. The data and information collected by means of the telescope will form part of the database of a network of small astronomical observatories in the east and south-east Asian region for possible collaborative research activities that will include the Philippines.

Table

Some of the space activities conducted by the National Mapping and Resource Information Authority for young people

Activity	*Coordinator/sponsor*	*Theme/objective*	*Description*
Children's Science Interactive Workshop	Philippine Society of Youth Science Clubs, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the University of the Philippines National Institute for Geological Sciences, the Department of Education, Culture and Sports, the Provincial Government of Bohol and the Local Government of Panglao	The science clubber, the Earth and the universe: "One small step for a man, one giant leap for mankind"	Discussions on rock identification, volcanism, plate tectonics, planets and heavenly bodies (planetary motion, comets, planet properties and features, open forum), stargazing and games.
Astroquiz; Astro Olympiad	PAGASA		A quiz contest among high school students.
Film about space travel	Manila Science High School	Space travel	Film screening for third- and fourth-year physics students.
Astronomy Club (meets at the University of the Philippines—Diliman)	La Salle Greenhills, Assumption School		
Astronomy-related activities	Philippine Astronomical Society	To foster widespread interest in the study of astronomy	Observations/stargazing; annual conventions; National Astronomy Week.